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Forthcoming Events.

AUGUST 26-28.

Iron and Steel Institute:—Autumn meeting at Stockholm, Sweden.

SEPTEMBER 27-OCTOBER 1.

American Foundrymen's Association:—International Foundrymen's Congress and Exhibition at Detroit, U.S.A.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Education or Training—Which?

At the large and representative meeting last November, arranged jointly by the Cast Iron Research Association and the Birmingham Branch of the I.B.F., and addressed by M. Ronceray, there was a demand that a committee should be set up to consider further the important question of education and training for the founding industry. While no specific steps have yet been taken, it is understood that the considerations involved are being very carefully explored, and the views of individual founders on the matter would be of the greatest help.

There is no need to restate the problem at any length. The quality of young men entering the industry as apprentice moulders and craftsmen is far too low, and in the industry itself there is inadequate practical training. The courses at evening technical schools are not suited to the requirements of the workman, and the attendance on the part of young foundry employees is small. To some extent the steady introduction of the moulding machine is discounting the need for straight craft skill, but it is at the same time increasing the need for a high level of intelligence and that unusual and specialised sense known as common sense.

A limited number of workmen are, of course, capable of becoming foremen and managers, but they have comparatively few opportunities of fitting themselves really adequately for these posts. In addition, we have emphasised before that there is practically no machinery whereby a technically trained man can enter the industry, for the reason that he, too, stands in need of further training, although in his case this further need is for practical knowledge to complement and complete his technical efficiency.

Any new proposals must take all these facts into account, and a sound scheme, having considered them as a whole, will make provision accordingly. For the subject constitutes one problem, and cannot be cut up into water-tight sections.

We would suggest that employers and workmen give their careful consideration to the whole question, and let us have the benefit of their views briefly for publication in our correspondence columns. In so doing it would be well to keep in mind the progress made of recent years by other industrial countries, and the relationship that such progress may bear to their educational systems and their faith in education itself. Any thorough comparison will force us to the conclusion that the British worker gets his knowledge by direct experience and by picking it up from his colleagues and superiors, a method which is as expensive as it is unsatisfactory.

We are fully aware that the apparent indifference to education displayed in this country is less indifference than a real antagonism, due to the suspicion that too much education is bad, whether for the workman or the manager. But such opposition is admittedly due less to education as such than to our present educational system, which produces the anomaly of the elementary school child who can barely spell or write decently, yet excels at half-a-dozen fiddling accomplishments; which produces, too, the graduate of metallurgy or engineering for whom there is no place in the industry he was designed to enter; and which has no means of recognising the services of competent and efficient business men who happen to be strangers to its academic routine and organisation. But if this is true, it is because business men have left education too much in the hands of those professionally interested, and this, so far from providing an excuse for having nothing to do with it, should be a doubly strong reason for a connection between industry and education while there

is yet time. Only then will there be an end to the cultivation of the unessential at the cost of the essential.

The founding industry is not called upon to choose between education and training as a method of preparation for its ranks. If the disadvantages of the present system of haphazard recruitment are to be minimised, it must have both.

In order to have a different view point, we print elsewhere an article on this subject by Mr. Eric N. Simonds, who is attached to one of the most progressive of British foundries.

Smoke Abatement.

Mr. C. Stanley, the well-known exhibition director, has organised a Smoke Abatement Exhibition to be held at Bingley Hall, Birmingham, from September 6 to 18, 1926. It is held under the auspices of the Smoke Abatement League of Great Britain, and under the patronage of most of the principal national technical societies. A feature of the exhibition is to be the "Perfect Boiler House," a composite exhibit evolved with the object of demonstrating the maximum efficiency to be expected when using the most modern type of plant.

American Malleable Castings Lawsuit.

A long drawn out legal battle between the American Government and the American Malleable Castings Associations has just finished. It was an action under the Sherman Anti-Trust and was terminated when the 87 defendants entered pleas of *nolo contendere* in the Federated District Court at Cleveland, Ohio.

The action was started against the Association, affiliated companies and its individual members in March, 1924. The defendants were alleged to be manufacturers of 75 per cent. of the annual production of malleable castings in the United States and were charged with having conspired since January 1, 1917 to assign and allot amongst themselves the buyers of malleable castings and to fix the prices for such commodities. These castings mainly go to the motor-car and agricultural implement manufacturers. Legal resources were exhausted by the defendants and many cases were heard in various parts of the country to force an appearance at the Cleveland Court.

September 17 was set down as the day for the hearing, but by entering pleas of *nolo contendere* it indicated their decision not to contest the proceedings further. The 87 defendants were fined $2,500 (£500) each or $217,500 in all. Five other defendants who entered similar pleas a few weeks ago paid fines totalling $14,500 so that the aggregate fines amounted to £46,400.

Foundry Trade Union's Finances.

The foundry workers unions had in 1924 178 branches, with 35,542 members and £17,166 as funds. Its income was £251,798, and expenditure £246,977. The funds for the beginning of 1925 were £22,192, when there were two fewer branches and 841 less members. The income, however, was higher by £39,593, whilst expenditure grew by £41,465. The funds at the beginning of 1926 were £24,936.

Foundry Statistics.

During June the United States exported 1,369 tons of pig-iron, 4,848 tons of cast-iron pipes, 1,085 tons of iron castings and 358 tons of steel castings. They imported during the same period 43,106 tons of pig-iron, 7,818 tons of cast-iron pipe. The export figures for France in metric tons were:—Pig-iron, 38,521 tons, and castings, 26,082 tons. The import figures for the two entities were 1,842 tons and 359 tons.

Esthonia imported during 1925 1,271 tons of pig-iron, as against 738 tons in 1924, some of which came from the United Kingdom.

During July Germany cast 94,375 tons of foundry pig-iron, as against 102,032 tons for July, 1925.

France for the first half of this year cast 880,273 tons of foundry pig-iron.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Inter-relationship of the Properties of Cast Iron.

To the Editor of The Foundry Trade Journal.

Sir,—We hear of many interesting theories in the world of cast iron and Dr. Klingenstein's Paper in your issue of August 19, on the relationships of mechanical properties of cast iron to each other and to analysis is amongst these.

He seeks to prove that as C + Si are increased in total ratios so the transverse tests fall away.

He also gives what is at least an interesting theory of the more rapid falling away of tests at about 5 per cent. (C + Si) total being caused by the gradual disappearance of the ferrite. The theory is based upon a 30-mm. test bar, but if this theory is correct why does the curve of the 20-mm. test bar show a more sudden collapse as the ferrite disappears?

Some 15 years ago I carried out tests on various sizes of bars and proved that tests increased as grain size decreased. These tests were published about that time, but it was not until 1920, at the request of the late Dr. J. E. Stead, that I showed a table at the Iron and Steel Institute Conversazione (1920) demonstrating that not only did transverse tests increase as grain size decreased, but that Brinell hardness increased in the same way. Samples of these actual test bars were also shown, and the whole series is still in my possession. This table will be found in my Paper before the Manchester Association of Engineers in March, 1923.

Both these theories have since been confirmed by Bell-Adamson and the theory of grain size is now acepted by H. J. Young in his Paper at the Glasgow (1925) conference of the I.B.F.

In Dr. Klingenstien's Paper, there is no greater proof that tests vary according to grain size than a comparison of the 30-mm. and 20-mm. test bars in his Fig. 2 and also Fig. 5, the latter, the smaller bar, being closer grained, and if he will follow through his research on the same lines with regard to Brinell hardness he will no doubt confirm that grain size has quite as much to do with hardness as has composition. The hardness tests must, of course, be taken from positions which will be strictly comparable, as the Brinell figure varies materially as the test is taken further away from the surface.—Yours, etc.,

E. Adamson.

Sheffield, August 21.

[This letter has been slightly condensed.—Ed.]

Catalogues Received.

Building Material.—Messrs. Venesta, Limited, of 1, Great Tower Street, London, E.C.3, have sent us a twelve-page brochure, detailing the commercial application of Plymax, which is a combination of three-ply wood and metallic sheets. It is used for the construction of motor-car bodies and for partitioning off rooms.

Monel Metal and Its Uses.—Messrs. G. & J. Weir, Limited, of Cathcart, Glasgow, have sent us Brochure No. MM7—an excellent example of modern publicity. Its general presentation is artistic, whilst technically the message has obviously been framed by engineers for engineers. After a statement as to the nature of the alloy and its physical properties, with special reference to corrosion, there follows the forms in which it can be supplied. Here we see no reference to ingots for remelting—a form which would be of outstanding interest for our readers. Three pages are devoted to the industrial applications of Monel metal and seven to the enumeration of the names of firms using the metal, together with their particular applications. Apparently no firm is using Monel metal for golf clubs, a use to which it has been put in the United States.

Much specialised literature is available on this subject, and we should imagine that the one entitled "Welds in Cast Iron that are Easily Machineable" should be of considerable interest to our readers. The brochure contains 20 pages and is jacketed in stiff watered blue-grey backs with deep blue letters and ornamentation.

Training Boys for the Foundry.

By Eric N. Simons.

Rigorous apprenticeship schemes are seldom of value in the foundry trade. First of all, the circumstances are such that quick and consistent production are required, with as little surplus labour as possible. Consequently, there is little time for the steady and skilled tuition in a craft or trade that the apprentice proper would naturally expect. Again, the employer is rigid in his insistence upon his right to dismiss. But when an apprentice is legally bound for a period of five or seven years, he can only be dismissed during that time after a number of tedious formalities have been complied with. Similarly, if the apprentice himself breaks his indentures, it is a bothersome and unprofitable matter to punish him for it. Yet the trouble and time and cost of teaching him have been thrown away without any compensation.

Apprentices in the foundry industry are also disliked for psychological reasons. Knowing that they are secure for a good long time, boys are often inclined—unless extremely intelligent and firm-willed—to let their work slide, or at all events, not to take it too seriously, seeing the folly of this procedure only when the time of their apprenticeship's expiration draws near. If other lads, not apprenticed, happen to be earning more money than they, there arise envy and slacking. Apprenticeship schemes usually include fixed rates of pay for each year, which lessens incentive. While such schemes do help employers to get the best out of a smart lad, they tend equally to help a lazy lad to get a good time out of his employer.

In the majority of foundries a system of "learnerships" is now in force. These usually comprise a precise verbal agreement between employer and lad that the latter shall have the opportunity to pick up a trade at the former's manufactory, though the employer is not bound to teach the lad. The lad's behaviour and abilities regulate his wages, his opportunities to learn, and the conditions of his work. Generally he is paid what he is worth, so that the faster he progresses the greater his wage becomes. This is a convenient, if loose, system, and it certainly causes less trouble than the fixed rate of the apprentice would. The employer is able to dismiss the lad if he is unsatisfactory or becomes a nuisance. But, on the other hand, he must give the lad a chance to acquire a trade or craft, with sufficient chances of promotion or good wages to induce him to remain in his employment. There are risks as well as advantages in this system, but on the whole it works, which outweighs any theoretical insufficiencies it may possess.

One may now examine the methods of training adopted. Most firms engage boys immediately on their leaving school, when they are fourteen years old, instead of waiting until they are sixteen. The advantage of such a step is that it prevents the boy from an early acquaintance with unemployment at a difficult age, and gives him an opportunity to gain some idea of the works and its organisation before he settles down to a particular trade. Almost always there are more lads available than there are places for them, so that the employer's choice can be careful. Since a learner's non-success means a loss of labour and money to the employer, it is to the latter's advantage to minimise the number of those failures by every means in his power. In one large steel foundry the lads engaged are often the sons of foremen or workmen already employed, whose characters are known, and whose services in guiding the lad can be utilised if necessary. This firm can boast that in many of its departments it has three generations of one family working; the grandfather a foreman, perhaps; the son a skilled mechanic; the grandson a learner.

If at any particular moment there are no sons or nephews of employees to receive preference, the headmasters of council schools are consulted, and asked to supply the firm with lists of recommended boys. These recommendations they are asked to base on general good conduct and character rather than on aptitude for any particular craft. In the last resort, though this is scarcely ever necessary, advertisement in the local papers is tried.

From the age of fourteen to that of sixteen, the lad is generally posted to the time offices as a works' errand-boy, though if he is specially capable, and has a good presence and school record, he may obtain work in one of the offices for a time. While engaged as errand lad, he is able to acquire a knowledge of the various departments and their processes, and the sharper he is, the more he picks up of his own accord. This knowledge will ultimately help him to decide on his future trade.

The same firm encourages its boys to go to evening school, to take either the usual continuation classes or a fixed course of tuition at some craft-school or other. Each year prizes are given to those who have been successful in the examinations that follow these classes, and it has been found that these prizes foster a desire to study seriously. It is perceived now that the better-educated and sharper the lad, the more skilled and useful will the eventual worker be, and that in the maintenance of British engineering supremacy trained and intelligent workers are essential.

When the lad reaches the age of sixteen he has to choose his trade, becoming either pattern-maker, smith, coremaker, moulder, labourer, or whatever he fancies. For the purposes of exposition, one may assume that he decides to become a coremaker. Coremaking is a highly-skilled trade. Naturally, a good period must elapse before the lad can be safely left to make cores by himself. Someone must teach him first, and he must during this time of tuition be constantly employed. He must also have an opportunity to get on, and be carefully watched and supervised. He will have to learn different ways of coremaking, and all the varying rules and regulations governing it. For all this time is necessary.

It must not be forgotten that after a few months at the work, he may discover that he has no liking or aptitude for it. He should have the chance to change over to another occupation, for the employer reaps no benefit from compelling a boy to stick at a job for which he is not suited, either temperamentally or physically. For this reason, the first work the boy does in the core-making shop is to act as a run-about lad for the experienced coremakers. He shovels sand for them, does odd jobs for the foreman, and learns his way about the foundry. This gives him the opportunity to see skilled coremakers at work, and if he is observant, he can learn a good deal from merely watching. He can ask questions; and simply through being called upon to pass the men the various tools they need from time to time, he gets to know their names and uses. This explains why foundries do not favour separate learning shops or rooms for their lads. Although it is possible to keep a closer eye upon them when they are segregated, and their chances of "larking" are reduced, they are deprived of the excellent advantage of seeing work done as they themselves will eventually have to do it.

How long they remain as mere run-about lads turns largely, of course, upon their own abilities and aspirations. No fixed period exists. Some lads can be trusted to make little cores by themselves after two or three months in the foundry. Others want a longer time. The foreman or whoever has the task of keeping an eye on the lads is able to judge pretty well how soon they may be given a chance to waste their employer's money by making bad cores.

Strictly speaking, the foreman is the person who should ensure that the boys get the tuition they need, and if he has the time and the wish, he usually does this work thoroughly. But in big works the foreman has not always the time at his disposal. In such cases the lad is usually put under the care of an experienced hand, who keeps an eye on him, puts him right when he goes wrong, explains his mistakes, and teaches him how to do things correctly. The foreman needs to discriminate carefully in his choice of these tutors, for not all workers are willing to reveal the tricks of their trade to beginners. Often the men themselves were apprenticed formally in their youth, and may have had premiums paid

for them by their parents. They resent the ability of youngsters to acquire without cost the trade that they had to pay to learn. Sometimes they feel that if they teach the lads all they know they will be supplanted by them in a few years' time. But as a general rule, these grudging men are few and far between.

As a check on the foreman, the shop manager should have a record of the boys in his shop, and should occasionally inquire into their progress himself, to make sure that they are getting proper tuition.

Boys should not be forced into taking up, or be allowed to take up, work for which they are not strong enough; and if, after a time, they show signs of physical distress as a result of their occupation, which may be too heavy for their years, perhaps, they should be given a chance to try another trade. A welfare department can do good work by organising sports and pastimes for them, and this will keep them fit and well.

National Fuel and Power Committee.

In accordance with the recommendation of the Royal Commission on the Coal Industry for the establishment of a National Fuel and Power Committee, the President of the Board of Trade has appointed a Standing Committee to consider and advise upon questions connected with the economic use of fuels and their conversion into various forms of energy, having regard to national and industrial requirements and in the light of technical developments.

The members of the Committee are:—

The Rt. Hon. Sir Alfred Mond, Bart., P.C., M.P. (Chairman).
Mr. J. Baker, M.P.
Mr. Mark Brand.
Sir John Cadman, K.C.M.G., D.Sc., F.G.S., M.I.C.E.
Sir Arthur Duckham, K.C.B.
Sir William Hart, O.B.E.
Mr. Frank Hodges.
Professor F. A. Lindemann, F.R.S.
Sir David R. Llewellyn, Bart.
Mr. M. Mannaberg.
Mr. C. H. Merz, M.I.E.E., F.R.G.S.
Sir Alexander Walker, K.B.E.
Mr. D. Milne Watson, M.A., LL.B., D.L.

The Secretary of the Committee is Mr. W. Palmer, and the Assistant Secretary Mr. R. J. Moffatt. All communications should be addressed to the Secretary, National Fuel and Power Committee, Board of Trade, Great George Street, London, S.W.1.

Mr. Baker represents the Iron and Steel Trades Federation, and is one of the Labour members on the Balfour Committee; Mr. Brand is a director of William Baird & Company, Limited, and of Sanquhar & Kirktunnel Collieries, Limited; Sir John Cadman is technical adviser, Anglo-Persian Oil Company, and a member of the Council of Scientific and Industrial Research; Sir Arthur Duckham is a specialist in furnace work, carbonisation of coal and engineering connected with chemical developments; Sir William Hart is the Town Clerk, Sheffield; Mr. Frank Hodges is the secretary of the International Miners' Federation, and was formerly General Secretary of the Miners' Federation of Great Britain; Professor Lindemann occupies the chair of Experimental Philosophy at Oxford, and was director of the Physical Laboratory of the R.A.F., Farnborough, during the war; Sir David R. Llewellyn is a director of many colliery companies, and of Guest, Keen & Nettlefolds, Limited; Mr. Mannaberg is a director of United Steel Companies, Limited, Bolckow, Vaughan & Company, Limited, Frodingham Iron & Steel Company, Limited, Appleby Iron Company, Limited, and Chairman of the Fuel Economy Committee of the National Federation of Iron and Steel Manufacturers; Mr. C. H. Merz, a consulting engineer, senior partner of Merz & McLellan, Westminster and Newcastle, and is a specialist in electric traction and power supply problems and fuel economy; Sir Alexander Walker is a director of John Walker and Sons, Limited, distillers; and Mr. Milne Watson is a governor of the Gas Light and Coke Company.

Book Reviews.

The Brass Founders' and Finishers' Manual. By Philip Gates. Published by Crosby Lockwood & Son, Stationers' Hall Court, Ludgate Hill, London. Price 5s. net.

In the preface to this book, the author states: "There are, moreover, numerous people, such as Progress Officials, Cost Clerks, Chasers, etc., who, whilst not requiring detailed information, stand in need of a good surface knowledge to enable them to co-operate intelligently." Herein lies the true value of the book. It cannot be recommended as a treatise on pattern making, or foundry work, as only seventeen pages are devoted to the former and fifty to the latter. In these fifty pages the author has dealt with Foundry Work; Foundry Sands; Core Sand; Facing Sand; Parting Sand; Loam; Boxes; Moulders Tools; Ladles; Crucibles; Core Making; Furnaces; Management of the Furnace; Fuels; Casting; Green Sand Moulding; Dry Sand Moulding; Examples of Green Sand Moulding; Chaplets; Casting a Thin Plate; Odd Side Moulding; Plate Moulding; Machine Moulding; Comparison of Hand with Machine Moulding; Jar Ramming; Disposal of Scrap. That gives an average of something less than two pages for each division, or sixty lines. Obviously, it has been impossible to enter very deeply into the component subjects. Chapter II (eight pages) is devoted to the various mixtures used, some of which are quite interesting, as they are taken from foreign sources. Cleaning Castings, Brass Finishing, Surface Finishing, Cleaning Brass, Polishing and Burnishing, Bronzing and Lacquering, and Soldering are the captions of the remaining chapters. The book contains 170 pages and 55 illustrations, and can be recommended for those requiring a superficial knowledge of the brass foundry business.

Grundbegriffe der Mechanischen Technologie der Metalle. By Dr. Ing. Georg Sachs. Published by Akademische Verlagsgesellschaft, m.b.H., 4 I Markgrafenstrasse, Leipzig. Price 15 gold marks.

This treatise on testing and the physical chemistry of metals and alloys should be studied by all research works. It is the most carefully indexed work that has passed through our hands for a long time, whilst its author is certainly one of the best read metallurgists in Europe. It can be consulted with the confidence of being sure to find abundant, if not complete, references to the knowledge sought. In his section on mechanical testing, the author has attempted to show, often mathematically, the real information to be extracted from the performance of any of the recognised tests. Many workers are inclined to stress the relationship between the tests, rather than to derive the full information offered by its isolated performance.

In Section II, which deals with the structure of metals and alloys, the author has, with advantage, departed from the usual scheme of such books, and by omitting the classical examples of starting with salt freezing, then pure metals, followed by examples of binary, ternacy, and complex alloys, has made a much more interesting book. He commences with crystallography, places the metals in their fixed systems, and deals with the properties of a single crystal. Then, of course, the question of crystal aggregates follows naturally, and is dealt with from varying angles.

The third section deals with the physical properties of metals and alloys. This section is well illustrated by numerous diagrams and micros. These latter are as well produced as the paper used will allow, but their excellence is such that they warrant a special art paper.

Finally, we would refer again to the splendid way in which the book is indexed.

The Future of British Industry and Trades Unionism. By G. Holt Thomas. Published by Odham's Press, Limited, Long Acre, London, W.C.2. Price 6d. net.

This very interesting little book, being of a quasi-political character, is difficult to review without showing partisanship. Viewed from the economic aspect—so closely allied to the political—the book contains many strong arguments for intense maximum personal production with the object of lowering ultimate sale price.

German Foundrymen's Association.

Annual General Meeting.

By Hubert Hermanns.

The "Verein deutscher Giessereifachleute" (German Foundrymen's Association), which embraces all the leading German foundrymen both on the scientific and practical sides, and which should be distinguished from the "Grey Iron Founders" (an organisation for promoting the industrial interests of iron-founding), held its annual general meeting in Berlin from June 4 to 6.

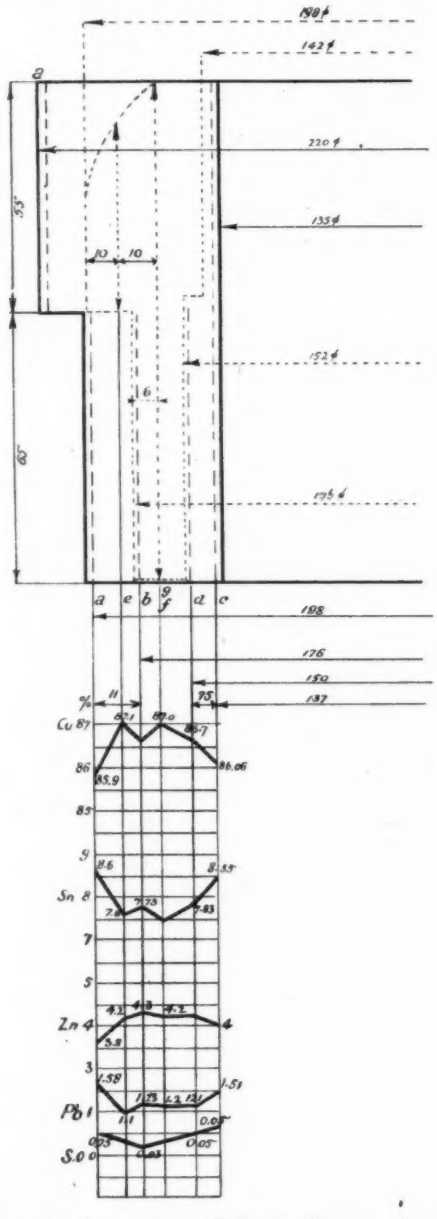

FIG. 1.—SEGREGATION DUE TO UNEVEN SECTION WHEN CAST IN DRY SAND.

The President of the Society, Dr. Dahl, in his opening speech, gave a short account of the development of the economic, scientific, and practical sides of iron-founding since the formation of the Association in 1903. The most important scientific work of the Society at the present time is that directed towards the improvement of chill castings, both non-ferrous, and grey iron and steel castings. The greatest significance is, however, attached to the improvement in the quality of grey cast iron. Foundrymen in other countries, too, are aware that a number of new processes have been elaborated and tried out in Germany for improving the strength and physical properties of grey cast iron. The processes best known at present are the Lanz pearlite process and the Thyssen-Emmel process, which are both based on different principles. As regards the

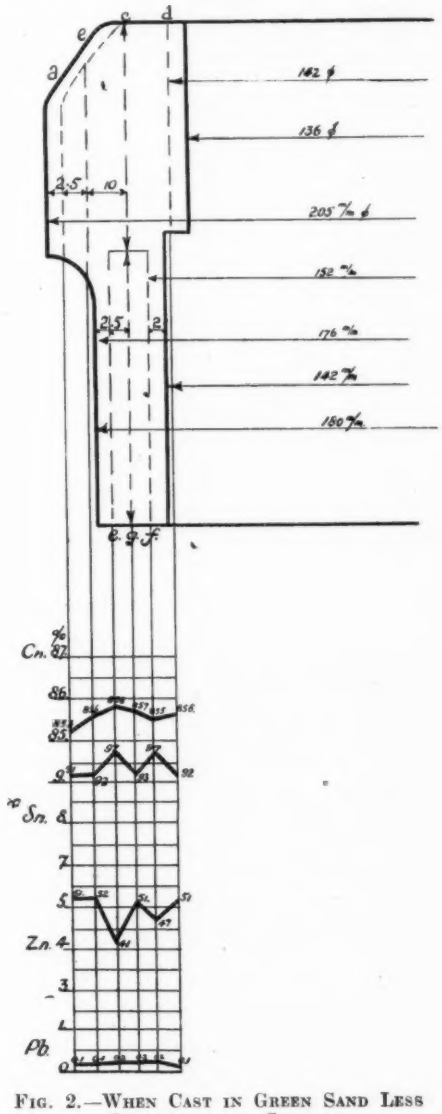

FIG. 2.—WHEN CAST IN GREEN SAND LESS SEGREGATION IS SHOWN.

present position of the production of improved quality grey cast iron, a number of papers were read at the meeting, a summary of the principal contents of which will be given below.

Prevention of Porosity and Improvement in the Physical Properties of Gunmetal.

By W. Reitmeister.

The object of these experiments was to find a substitute for the uniform type of gunmetal containing 85 per cent. copper, 9 per cent. tin, and 6 per cent. zinc, hitherto used by the German

railways. This alloy freezes between about 750 and 1,000 deg. C. As a result of this, thick cross-sections do not cool uniformly all over. These temperature differences at different parts of the castings cause segregation, which is always present in heavier castings. The phenomenon of segregation may be seen from the analyses in Fig. 1. In contrast to this type of casting, which calls for a large pattern and a dry mould with slow cooling of the castings, Fig. 2 shows a casting cast in a green sand mould. Whereas the casting made as per Fig. 1 exhibited extreme sponginess and very bad physical properties, the casting made in accordance with Fig. 2 was quite compact and of normal physical make-up. Sponginess is first revealed on subjecting the casting to a hydraulic test, upon which the water gushes from the pores as from a sponge.

Other experiments were carried out to determine the effect of the position of the tensile test bars within the casting, and the method of casting, whether oblique, vertical, or horizontal, using dry and green sand moulds. Table I contains the results of the physical tests on various specimens taken from a gunmetal casting containing 2.5 per cent. lead. The figures given will show the superiority of the castings made in the green sand mould.

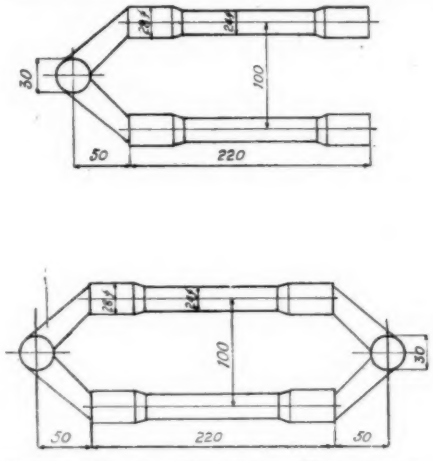

Fig. 4.—Form of Test Piece Used by the German State Railways.

Table I.—*Physical Properties of Test Specimens of Gunmetal in Terms of Mould and Method of Casting Used.*

Sand Mould.	Method of Casting.	Diameter of Bar. Inches.	Breaking Load. Tons. sq. in.	Elongation %	Coefficient of quality.	Analysis.			
						Cu.	Sn.	Zn.	Pb.
Dry ..	Vertical ..	1 3/16	6.6	2	11.5	83.4	5.1	9.1	2.4
Dry ..	Vertical ..	2 11/16	7.66	4	16.1	83.4	5.1	9.1	2.4
Dry ..	Vertical ..	2 11/16	7.98	3	15.6	83.4	5.1	9.1	2.4
Green ..	Horizontal	1 3/16	12.05	14	33.0	82.7	5.3	9.5	2.5
Green ..	Horizontal	2 11/16	9.06	10.0	24.3	82.7	5.3	9.5	2.5
Green ..	Horizontal	2 11/16	10.45	10.0	26.5	82.7	5.3	9.5	2.5

With a view to equalising the temperature differences in the solidifying castings, they must be so designed that thick cross-sections of high heat capacity do not lag too far behind the thinner cross-sections in cooling. In contradistinction to the generally accepted opinion that the thick cross-sections should be placed downwards, they should be placed upwards in the mould. Further, the sand used must be thoroughly permeable to gases and conduct heat well. For ascertaining the work of compression and the gas-permeability of moulding sands, a special process* was adopted, using the test arrangement shown in Fig. 3. This method of testing consists in measuring the time taken by a constant volume of air, raised to a definite pressure, to expand completely when forced through a uniformly compressed layer of sand. For this purpose a small hand bumping machine (Fig. 3, right) is used. In this machine the sand is compressed in the tube by turning the hand wheel, and the decrease in volume ascertained after 50, 100, 150, and 200 revolutions of the wheel. The tube is then connected hermetically with the test apparatus shown to the left.

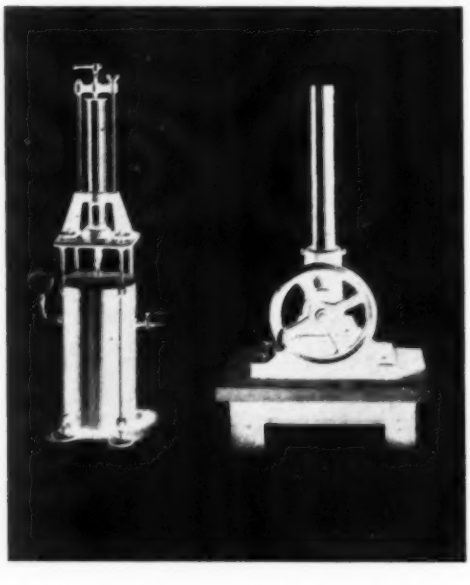

Fig. 3.—Apparatus for Testing the Permeability of Sand.

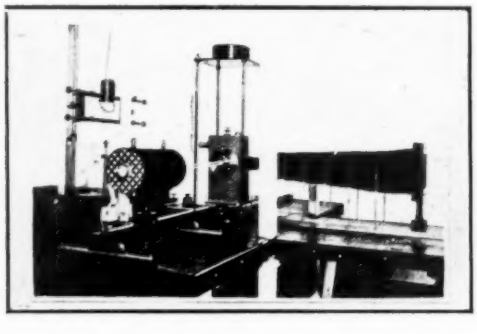

Fig. 5.—Dilatometer Used in the Tests.

The compressed air escapes upwards through the pores of the sand.

The compression curve of two different sorts of sand, which behaved differently when subjected to the same amount of compression, showed that both sands may be regarded as very non-permeable. In Sand II the non-permeability to gases is due to the high percentage of clay—viz., 32.8 per cent. In Sand I, it is caused by too high a percentage of small grains—viz., 87.9 per cent.

The result of segregations in the castings is that they become irregular in their chemical composition, and do not remain homogeneous. Unless the considerable amount of segregation is entirely eliminated by the chilling effect of the sand mould, there is a concentration of a high-tin filler at certain parts, and high-copper mixed crystals at other parts. The former are hard and the latter soft in consistency. Segregation not only impairs the strength and ductility of the castings, but also the wearing properties. Com-

* This machine was exhibited at the recent Foundry Exhibition.

parative tests carried out on various gunmetals to determine the resistance to wear after 200,000 revolutions of the testing machine gave the figures shown in Table II:—

In spite of the higher percentage of tin, gunmetal alloy No. Rg. 5 is six times as wear-resistant as Rg. 9. The Brinell hardness of the former is also much more uniform.

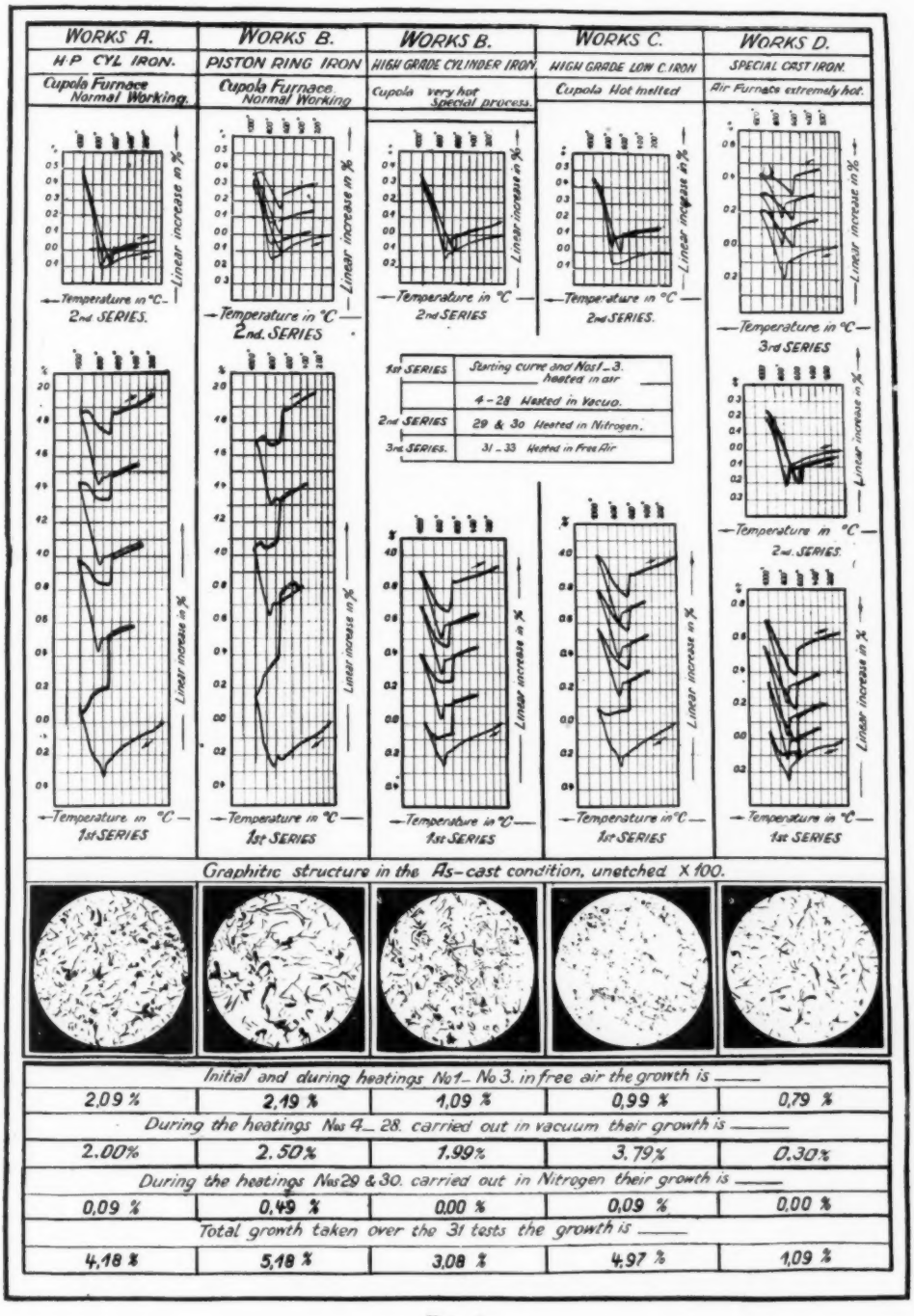
WORKS A.
H.P. CYL. IRON.
Cupola Furnace Normal Working.
WORKS B.
PISTON RING IRON
Cupola Furnace Normal Working
WORKS B.
HIGH GRADE CYLINDER IRON
Cupola very hot Special process.
WORKS C.
HIGH GRADE LOW C. IRON
Cupola Hot melted
WORKS D.
SPECIAL CAST IRON.
Air Furnace extremely hot.
Linear increase in %
Temperature in °C
2nd SERIES.
1st SERIES
3rd SERIES
1st SERIES Starting curve and Nos 1–3. heated in air
4–28 Heated in Vacuo.
2nd SERIES 29 & 30 Heated in Nitrogen.
3rd SERIES. 31–33 Heated in Free Air
Graphitic structure in the As-cast condition, unetched X 100.
Initial and during heatings No 1–No 3. in free air the growth is
2,09 % 2,19 % 1,09 % 0,99 % 0,79 %
During the heatings Nos 4–28. carried out in vacuum their growth is
2.00% 2.50% 1.99% 3.79% 0.30%
During the heatings Nos 29 & 30. carried out in Nitrogen their growth is
0,09 % 0,49 % 0,00 % 0,09 % 0,00 %
Total growth taken over the 31 tests the growth is
4,18 % 5,18 % 3,08 % 4,97 % 1,09 %

FIG. 6.

TABLE II.—*Results of Tests Carried out on Wear of Gunmetal.*

Material.	Brinell Hardness.	Loss of Weight.		Chemical Composition.					
		Single Values. Grams.	Mean Grams.	Cu.	Sn.	Pb.	Zn.	Ni.	Fe.
Rg. 5	52.1	0.9064	0.8593	82.8	5.7	2.3	9	0.1	0.1
Rg. 5	55.4	1.0162							
Rg. 5	54.1	0.6554							
Rg. 9	56.4	1.1576	5.1144	86.3	7.9	2.0	3.4	0.3	0.1
Rg. 9	61.5	5.1570							
Rg. 9	73.3	6.3738							
Rg. 9	60.6	6.0318							
Rg. 9	53.1	6.8520							

Experience and the test results show that it is extremely difficult to standardise gunmetal alloys. It is, of course, possible to classify the alloys according to analysis tolerances. Physical values can also be drawn up for the standardised

Melt No.	I.	II.	III.	IV.	V.
C%	3.55	3.04	2.89	2.98	3.42
Graphite	2.78	2.03	1.73	1.64	0.06
Si.	2.13	1.08	0.97	1.14	1.00
Mn.	0.50	0.43	0.46	0.47	0.48
S	< 0.03	< 0.03	< 0.03	0.12	< 0.03
P	Tr.	Tr.	0.63	Tr.	Tr.
Cr.	—	—	—	—	1.12

Fig. 7.

alloys. It is impossible, however, to lay down that the castings made from a standardised alloy should exhibit at every part the physical properties possessed by the standardised alloy. In their work carried out to arrive at a suitable tensile test bar for standardised cast bronzes, the German State Railways have suggested the form of test-bar shown in Fig. 4. The tensile test-bar is the proportional short bar 24 mm. in dia., turned down to 20 mm. The sand-mould used must be green sand. The method of casting shown at the top of Fig. 4 is not free from objection, because, owing to the accumulation of metal at one side caused by the ingate, the metal does not cool uniformly. This drawback is eliminated in the arrangement shown at the bottom of Fig. 4. But even in this case it is not possible at once to deduce the property of the castings from the testing of cast-on tensile test-pieces.

The Effect of Growth and Shrinkage on the Properties of High-Quality Grey Cast Iron.

By Dr. E. Piwowarsky.

The progress recently effected in raising the quality of grey cast-iron is based upon the systematic refining of the graphite. During the last few years the writer has carried out valuable investigations in this direction in the Ferrous Metallurgical Section of the Aachen Technical College, principally to determine the effect of overheating the melts upon the properties of high grade grey cast-iron. The more recent experiments were carried out to ascertain whether it would be possible to obtain cast-iron free from casting stresses by reducing shrinkage to a minimum, especially in the interval just below the temperature of solidification. The experiments have also been directed to obtaining a comparatively high degree of resistance to corrosion and permanence of volume at room temperature, and, particularly, at higher temperatures.

Practical tests were carried out, when it was found that an increasing degree of refining of

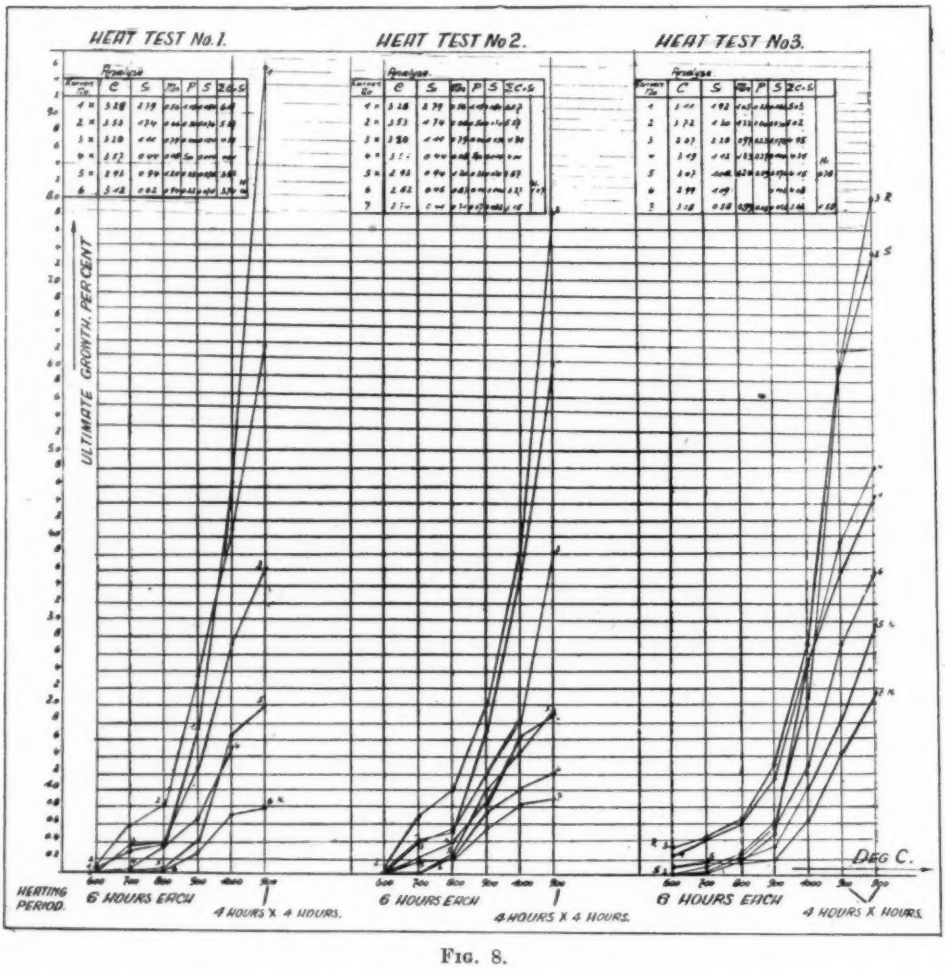

Fig. 8.

the graphite occurred with the same rate of cooling, even where cooling was very slow, according to the degree of superheating applied to the melt. Laboratory experiments with three casts of the same composition (T.C., 3.0; Si, 2.2; Mn, 0.45; and P. 0.02 per cent.), which were overheated to 1,260 and 1,420 (or 1,590) deg. C., and allowed to remain in every case for 10 minutes at the maximum temperature, and then each cast into a bar 30 mm. dia. and 500 mm. length, showed

that not only the rate of cooling but also the degree of overheating exerts a similar effect on the position of the eutectic temperature. The increase in size of the graphite decreases with the degree of superheating. This systematic refining of the graphite is due, in the ultimate analysis, to systematic under-cooling of the melts without increasing the speed of cooling.

This systematic and abnormal heating of the melt gives an extremely useful and valuable process for the manufacture of high-quality cast-iron. By using this process in the production of high-quality cast-iron, tensile strengths of up to 42 kg/mm.² (26.5 tons/sq. in.) and specific transverse strengths of as high as 73 kg/mm.² (46.3 tons/sq. in.) were possible without subsequent treatment. In this abnormal overheating of the melt, equalisation of temperature in the casting is promoted before solidification is complete. With increasing temperature difference between the edges and centre, shrinkage, however, decreases. Experiments carried out for the purpose of numerically measuring the shrinkage at the same casting temperature in terms of increasing overheating did not give any definite result. But the effect of an increasing silicon content on the reduction of shrinkage was certainly shown. The shrinkage is shown in Table III, *i.e.*, the actual shrinkage and expansion separately, and the apparent total shrinkage resulting.

Piwowarsky attributes expansion to the segregation of gases during the transition from the liquid to the solid state. The very favourable effect of overheating leads to greater compactness of the normal highly-heated cast iron in conjunction with the formation of the fine graphite. The increasing formation of carbide with increase in overheating may be explained by the shrinkage of mechanical parts of the graphite and with the increase in the carbide molecules in the melt. The increased fineness of the graphite which occurs even with moderate overheating of the melt is brought about by a gradual lowering of the eutectic critical point. The effect of the shrinkage of the graphite nuclei outweighs the effect of the gases, which tend in the opposite direction to eliminate under-cooling and increase the dissociation of the carbide in the cooling iron, and the effect of the decrease in the rate of cooling due to pre-heating the mould and the consequent higher casting temperature. The further refinement of the graphite observed where overheating is pushed still further is attributable to the great increase in the carbide formed spontaneously in the core in still larger regions of under-cooling, due to the gradual decrease in the gas evolved in the melt. The same effect can also be produced at slightly lower temperatures of approximately 1,400 to 1,500 deg. C., or by mechanically shaking the cast-iron melt.

TABLE III.—*Expansion at the Interval of Solidification at the same Casting Temperature in Terms of Overheating.*

Melt No.	C. %	Graphite %	Si. %	Heated to °C	Cast at °C	Actual Shrinkage %	Expansion %	Total Shrinkage %
1	3.26	3.02	2.24	1,300	1,250	0.385	0.352	0.737
2	3.30	2.51	2.18	1,450	1,250	0.320	0.529	0.849
3	3.23	1.99	2.24	1,600	1,250	0.753	0.240	0.993
4	3.52	3.08	1.74	1,300	1,250	0.497	0.192	0.689
5	3.36	1.71	1.54	1,450	1,250	0.833	0.448	1.281
6	3.56	2.22	1.74	1,600	1,250	0.432	0.417	0.849
7	3.28	1.51	0.82	1,300	1,250	0.933	0.256	1.189
8	3.02	1.23	0.98	1,450	1,250	1.008	0.481	1.498
9	3.24	1.16	0.92	1,600	1,250	1.300	0.0962	1.369

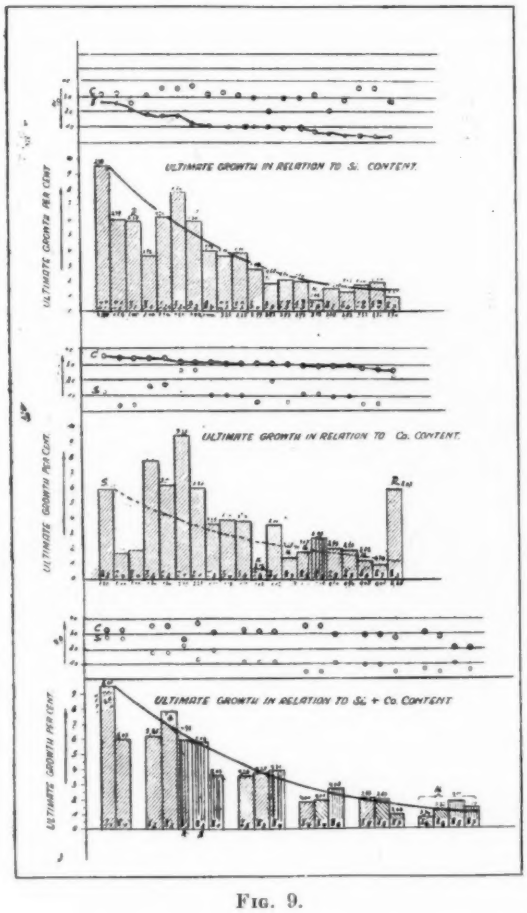
ULTIMATE GROWTH IN RELATION TO Si. CONTENT.
ULTIMATE GROWTH IN RELATION TO Co. CONTENT.
ULTIMATE GROWTH IN RELATION TO Si. + Co. CONTENT.
ULTIMATE GROWTH PER CENT.

FIG. 9.

To test the effect of overheating on the permanence of volume and resistance to corrosion five test bars were subjected to "growth" tests with the differential expansion dilatometer as shown in Fig. 5, the test temperatures varying between 400 and 1,000 deg. C. One cycle (alternate heating and cooling) lasted about two hours. The results of the tests are shown in Fig. 6. These tests show:—

That the two coarse-graphitic irons of works A and B, produced in the cupola furnace and con-

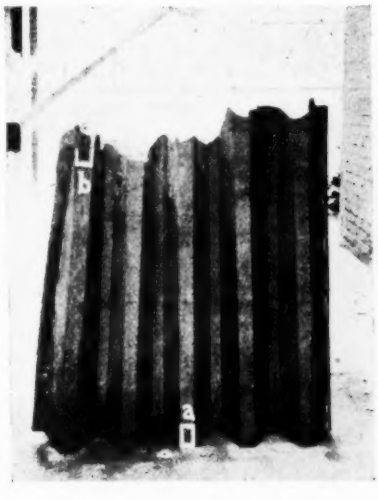

FIG. 10.—SAND-DRYING PLATE AFTER EXPOSURE TO PROLONGED HEATINGS.

taining 1.5 and 1.8 per cent. Si respectively, grow considerably.

That the "hot" cast high-quality iron of works B, also containing 1.8 per cent. Si, but having the graphite better formed, grows only half as much as the last-mentioned iron.

The best results were obtained with iron from works D, containing 1.7 per cent. Si and produced in the reverberatory furnace with regenerative heating.

The low-carbon iron, having finest graphitic structure but highest silicon content, from works C increases from growth very slowly at first, but reaches a considerable figure at the finish of these alternate treatments. The iron having the finest

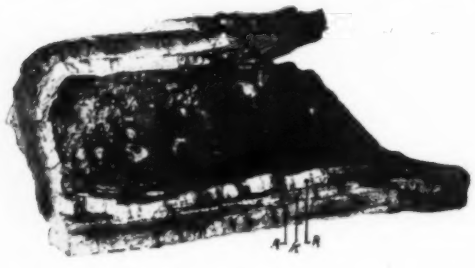

Fig. 11.—Detail of the Portion B of Fig. 10.

graphite formation (works C) may be rendered illusory in its effect by having a too high silicon content. A low-carbon content cannot compensate for the effect of too high a percentage of silicon tending to promote growth.

Where overheating is sufficiently drastic, a silicon content of even 1.7 to 1.8 per cent. will yield a material of constant volume.

A further series of tests were carried out on the growth of different cast irons in steam at temperatures of 300, 350 450 deg. C. for a period of 75 hours, when the results shown in Fig. 7 were obtained. The results of these tests may be summarised as follows:—

(1) In all irons, independently of their chemical

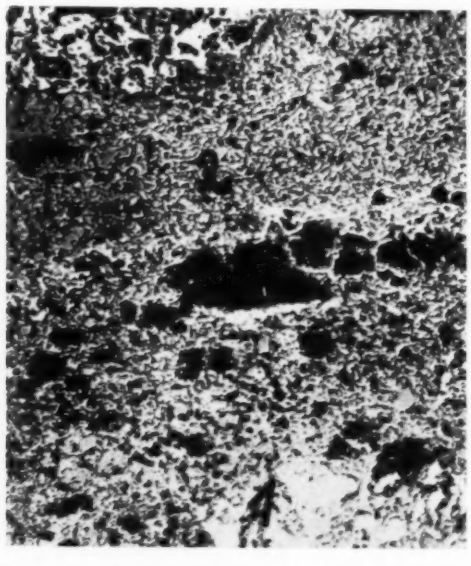

Fig. 13.—Structure of the Burnt Metal × 100 (Zones 1 and 2, Fig. 12).

composition, considerable deterioration of the surface, due to the increase of volume, occurred.

(2) At steam temperatures of 350 deg. C. only the higher silicon casts promoting the most unfavourable type of graphite formation suffered a noticeable oxidation of the core.

(3) After exposing to a steam temperature of 450 deg. C., oxidation increased considerably in the central portions of the higher-silicon and higher-sulphur samples, whereas the core of the lower-silicon melts II and III remained practically free from oxidation, owing to the better formation of the graphite. Melt V, a white iron containing chromium, shows in a marked degree the beneficial effect of a compact texture.

(4) In steam at temperatures of from 300 to 450 deg. C. the dissociation of the carbide was much more marked than is usual where a moderate amount of air is admitted.

(5) Treating the specimens in steam caused a loss in the percentage of total carbon of from 10 to 15 per cent.

(6) The results of the tests seem to show the possibility of producing a grey cast iron capable of standing up to high steam temperatures. On the other hand, a fine graphitic structure seemed

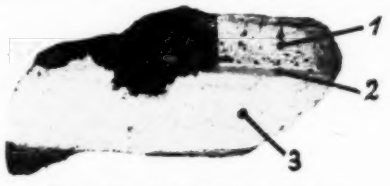

Fig. 12.—Illustration of the Transition Portions.

to be of no advantage when the irons were treated with dilute acids.

DISCUSSION.

In the discussion on the Paper, K. von Kerpely stated that his own experiments had not confirmed Piwowarsky's theory of the reversal of the combined carbon curve at the graphitic change temperatures between 1,400 and 1,500 deg. C. in the electric furnace. With an average composition of the samples (which were made at increasing temperatures up to 1,700 deg. C.) of C, 3.0 to 3.2; Si, 1.8 to 2.0; Mn, 0.8 to 1.0; P, 0.45; and S, 0.06 per cent., it was impossible to find any increase in the graphite formed or any reversal of the combined carbon curve. The processes of deoxidation play a very important part in cast iron. By a suitable slag treatment under an oxide slag, carbide slag, and a high-alumina clay slag, it is possible to produce a cast iron having a normal carbon content of 3.0 to 3.2 per cent.,

Fig. 14.—Structure of the Original Metal.

and by superheating, to obtain physical values not hitherto attained. The structure of the cast iron is extremely fine, but has no eutectic distribution of graphite, but the graphite is formed like a pure temper carbon. Kerpely has attained tensile strengths of considerably over 40 kg./mm.² (25.4 tons/sq. in.), with 3 to 4 per cent. elongation, and transverse strengths of over 70 kg./mm.² (44.5 tons/sq. in.).

Karl Sipp, manager of the Heinrich Lanz Foundries, and who developed the Lanz Pearlite Process on a practical scale, reported on experiments carried out to ascertain the cause of growth in cast iron. The growth of cast iron at high

temperature (600 to 1,000 deg. C.) is caused by the conversion of the combined carbon into graphite, the segregation of the graphite and oxidation of the iron. Three sets of tests were carried out with test-bars of 100 mm. (4 in.) length and 15 mm. (0.58 in.) diameter, obtained from casts with varying percentages of carbon and silicon. The total carbon *plus* silicon fluctuated between 0.68 and 3.15 per cent. with varying proportion of C : Si.

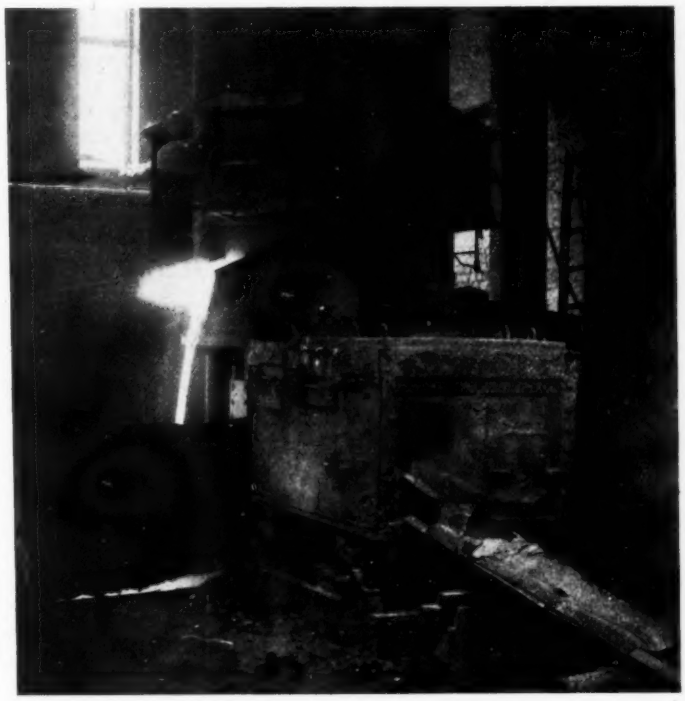

FIG. 15.—EXPERIMENTAL ARRANGEMENT FOR THE JOLTING HEARTH.

Two sets of tests were carried out in a Heraeus electric furnace with the free admission of air; the third set in a gas-heated furnace, at temperatures of 600, 700, 800, 900 and 1,000 deg. C. The specimens were heated for 6 hours at these temperatures, being afterwards heated four times to 900 deg. C. for four hours. The analyses of the samples will be found in Fig. 8. First of all, test series 1 was carried out, then, for purposes of verification, test series 2 up to bars 6 and 7. In the third set of tests new alloys were used and the gas-heated furnace employed for heating. The behaviour of the bars under this treatment is shown in the curves. These curves show that growth is proportional to the total C + Si.

Fig. 9 shows still more strikingly the influence of the total C + Si. The upper group is plotted according to the Si content, the middle group according to C content, and the lower group to the total C + Si. The curves also show that there is a definite relationship between the Si content and the C + Si content and the effects which the tests were carried out to show, whereas the carbon group of curves follow no rule. In the diagram shown, the alterations in structure in all stages of annealing between edge and middle of specimen of the 50 mm. (2 in.) specimens were clearly brought out. The results of these experiments were also confirmed by subsequent experiments carried out in special closed annealing boxes.

The observations made on a sand-drying plate are noteworthy, and go to confirm the test results. The plate shown in Fig. 10 was heated at the end *b* to red heat, whereas the portion *a* was not so strongly heated. The extent to which the part *b* is deteriorated is shown in Fig. 11. Three zones have formed. The two lateral zones have passed completely into the oxidised state. Even the middle zone is pretty badly attacked. The ferritic texture is intermixed with the oxidic texture. The transition of the middle zone to the outer zone is shown in Fig. 12: 1 represents the core, while 2 represents the transition to the outer zone 3. In the middle zone the carbon has diminished to 0.09 per cent. Fig. 13 shows the structure of the burnt material, the designations 1 and 2 corresponding to those of Fig. 12. Fig. 14 shows the material in the original condition. The analysis was as follows:—

FIG. 16.—(*Left*) PHOSPHIDE EUTECTIC IN THE JOLTED IRON, AND (*right*) IN THE UNTREATED IRON AT THE SAME MAGNIFICATION.

	C.	Si.
In portion *a* of the plate, which was not attacked	3.21	2.26
In portion *b* of the plate, core-zone ..	0.097	2.13
" " *b* " " " outer zone	0.029	2.44

Improving Cast Iron by Jolting.*

By C. Irresberger.

These attempts differ fundamentally from previous attempts to improve the quality of cast iron by thermal and chemical means. The object is, by mechanically moving the cast iron in the liquid state, to free it from gases and deoxidise it, to get thorough mixing, to render the sulphur harmless and to dissolve the graphite. Fig. 15 shows the experimental arrangement—a special shaking hearth in conjunction with a 6-ton cupola furnace.

Due to the way in which the hearth is moved, the iron bath is considerably agitated. The results of this method in so far as concerns the removal of gases were very satisfactory. Jolting promotes the development of gases, which, in addition to containing hydrogen, are formed principally of CO and SO_2. After jolting, the iron has an absolutely quiescent surface, and can be poured as smoothly as oil.

Fig. 16 (left) shows the phosphide eutectic in jolted iron, and Fig. 16 (right) the same eutectic in unshaken iron. Fig. 17 (left) shows the graphite and manganese sulphide in shaken iron containing 0.14 per cent. S, and Fig. 17 (right) the graphite and manganese sulphide in unshaken iron containing 0.136 per cent. S. Fig. 18 (left) shows the eutectic graphite of jolted machine iron, and Fig. 18 (right) of unjolted iron. The graphite occurred in coarse, fairly slender laminæ, as a result of which the strength properties of the iron are impaired.

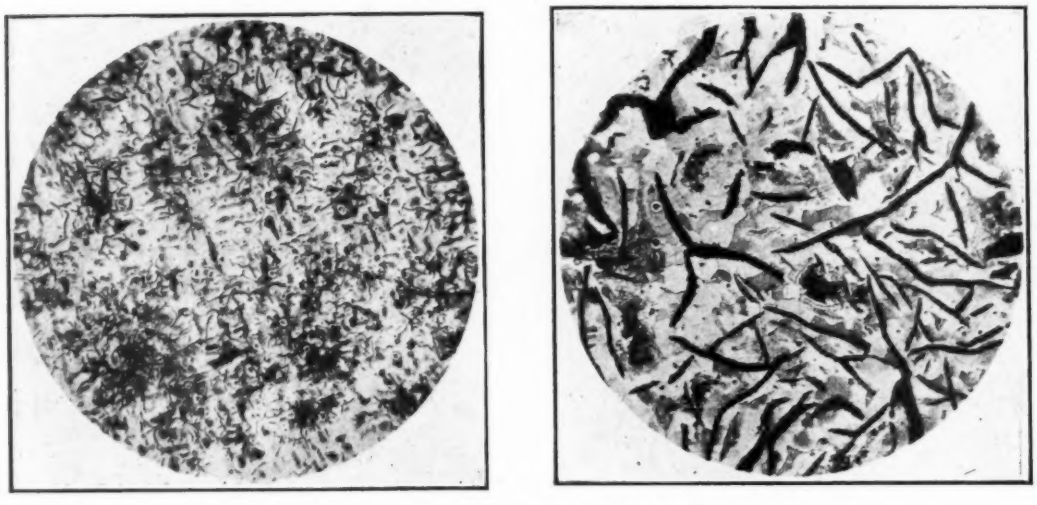

Fig. 17.—(*Left*) MnS in Jolted Iron and (*right*) in Unjolted Material.

Satisfactory results were also obtained when adding steel to the charge. The iron exhibited no hard places; and the tendency to solidify white—a property so feared in engineering work—was absent. Table IV shows the strength properties of jolted iron with varying proportions of added steel. A striking feature is the comparatively low Brinell hardness, which is explained by the high carbon and silicon contents.

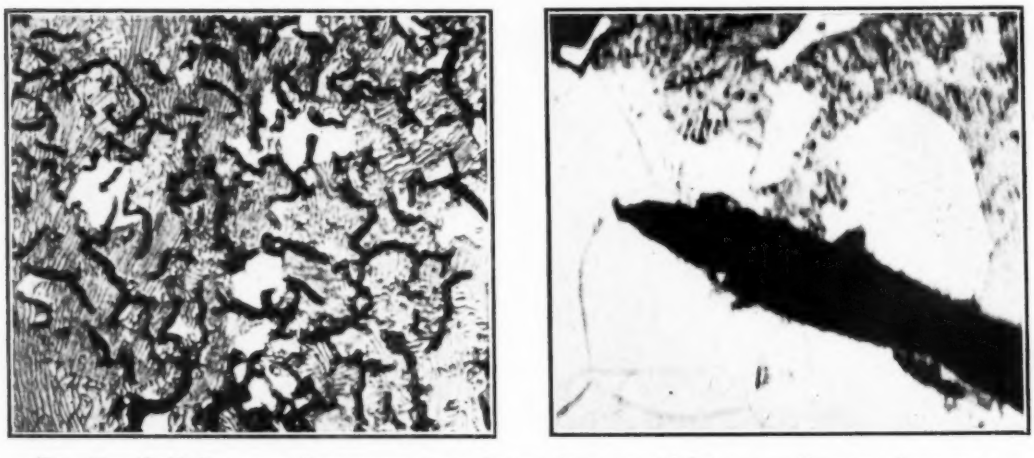

Fig. 18.—(*Left*) Graphitic Structure of the Jolted Iron and (*right*) in the Unjolted Condition.

Table IV.—*Experiments with Shaken Cast Iron contained added Steel.*

No.	Analysis. C %	Si. %	Mn. %	P %	S %	Kz (Tensile) Tons. sq. in.	Kb (Transverse) Tons sq. in.	f Deflection in mm.	Brinell Hardness.	Tapping Temperature °C.
R. 0	3.72	2.22	0.46	0.37	0.17	13.0	26.5	11.5	222	1320
R.10	3.20	2.27	0.56	0.38	0.08	16.5	32.3	12.5	216	1310
R.15	3.40	2.34	0.45	0.33	0.09	17.44	33.31	12.5	228	1300
R.20	3.38	2.15	0.42	0.37	0.13	19.0	35.85	12.5	217	1330
R.20	3.62	1.74	0.71	0.30	0.17	19.35	34.65	14.2	240	1300
R.30	3.48	2.15	0.45	0.20	0.13	20.30	35.22	14.0	215	1360
R.30	3.48	1.57	0.68	0.41	0.14	21.45	36.50	11.9	224	1340
R.50	3.02	1.83	0.40	0.34	0.14	21.25	39.03	12.5	215	1340
R.50	3.88	2.94	0.66	0.15	0.14	20.61	41.25	18.0	189	1350

* See also article on page 64 of July 22 issue.

Properties of High-Silicon Steel.

By Dr. E. H. Schultz and H. Buchholtz.

It is a well-known fact that silicon improves the physical properties of steel in many respects; it increases its density, improves its electrical properties, and raises its elastic limit. It is important from a metallurgical point of view that silicon should not only show no segregation, but even check the segregation of other alloying constituents. On the other hand, a considerable amount of piping has to be reckoned with. The weldability is also said to be reduced as a result of a high silicon content. As regards structure, silicon produces a coarsening of grain.

A low-carbon steel with a high silicon content has been proposed quite recently. The Association of German Iron and Steel Makers has meanwhile by comprehensive experiments ascertained that such steels can be produced in any open-hearth furnace, as well as in the basic or acid converter and the electric furnace. It is apparent from the iron-silicon diagram that silicon produces with the iron mixed crystals in the form of Fe_2Si, which bring about a consolidation of the material. In addition to this, the upper transformation point A_3 of the pure iron is displaced exceptionally quickly by the addition of silicon, while the point A_4 is lowered at the same time. With 1.7 per cent. Si the transformation of gamma iron into beta iron ceases. These properties are of importance in the case of steel castings and their annealing. With more than 1.7 per cent. Si a heat treatment for the purpose of an alteration in the size of grain will not produce any finer grain than is obtained by annealing for a short time above the point A_3 with subsequent cooling at average speed.

In the tests carried out conjointly by the two authors the toughness of the silicon steel in the small shock-test apparatus on notched bars (10 × 10 mm., with 2 mm. round notch) was about 12 mkg. per sq. cm., but depends, of course, on the mechanical and thermal treatment of the metal. The relationships between Si and C contents were ascertained by the examination of three melts of silicon steel with about 1 per cent. Si, which differed from each other practically only in their C content. Table I gives the correct analyses of the three melts:—

Table I.—*Analyses of the Silicon Steels Tested.*

Melt No.	C	Si	Mn	P	S
	%	%	%	%	%
10	0.09	1.01	0.66	0.015	0.040
15	0.14	1.04	0.71	0.015	0.038
20	0.19	0.99	0.66	0.024	0.044

The specimens were taken from universal flats 10, 15 and 22 mm. thick respectively, and were tested for their mechanical properties. The results of the tests are given in Table II:—

Table II.—*Strength of Rolled Silicon Steel.*

Melt No.	Size.	Elastic limit.	Tensile strength	Elongation.	Contraction of area.	Specific work in notch bar test.
	Mm.	Tons per sq. in.	Tons per sq. in.	%	%	M. kg. per sq. cm.
	10	23.5	32.8	26.0	46	10.2
10 ..	15	22.5	31.4	24.1	50	12.1
	22	21.0	31.1	23.3	44	12.0
15 ..	15	23.1	33.8	23.3	52	10.4
	22	20.3	33.5	24.5	48	14.2
	10	26.8	36.8	21.5	47	10.3
20 ..	15	23.6	35.5	23.0	50	9.4
	22	21.5	35.2	22.8	44	8.9

According to the results of these tests the influence of the carbon content is not so effective as might have been expected. On the other hand, the amount of work done in rolling to produce the different thicknesses of the universal flats has, of course, a great influence on the strength of the metal. With increasing thickness of the universal flat the elastic limit decreased very much, but the tensile strength only slightly, while in regard to elongation no decisive figures were obtained. By storing the test bars for a time, however, a considerable improvement took place as regards elongation. In Table III are shown the alterations in the mechanical properties of the metal after storing for 20 days in the air.

Table III.—*Influence of Storage on the Strength of Rolled Silicon Steel.*

Melt No.	Elastic limit.	Tensile strength.	Elongation.	Contraction.	Specific work in notch bar test.
	Tons per sq. in.	Tons per sq. in.	%	%	M. kg. per sq. c.m.
10 ..	−1.4	−0.6	+10.0	+25.9	0.0
15 ..	+0.1	−0.2	+ 5.4	+17.3	0.0
20 ..	0.0	−0.5	+ 6.7	+23.5	0.0

From the same three melts some wheels were cast, and the mechanical properties of the steel ascertained. Table IV shows the results of the tests for annealed and unannealed cast steel. The samples to be tested were taken adjoining each other from the rim of the wheel

Table IV.—*Mechanical Properties of Silicon Cast Steel.*

Melts.	Test pieces.		Elastic limit.	Tensile strength.	Elongation.	Contraction of area.	Specific work in notch-bar test.
	Taken from	Treatment.	Tons/sq. in.	Tons/sq. in.	Per cent.	Per cent.	Mkg./cm.²
10	Wheel rim	A	18.7	26.8	35.0	56	2.5
		B	20.3	30.4	22.0*	28*	10.3
		C	18.4	28.8	24.0	30	9.2
	Spokes	A	14.9	26.8	31.2	57	2.2
		B	18.6	28.2	31.0	63	14.6
		C	19.7	29.0	33.2	60	7.9
15	Wheel rim	A	15.5	29.0	25.0	28	4.9
		B	23.2	26.9*	5.0*	—	10.1
		C	19.0	30.3	26.0	50	7.6
	Spokes	A	15.9	28.9	29.0	48	4.0
		B	19.2	30.1	26.0	58	12.9
		C	19.6	30.6	32.5	58	7.6
20	Wheel rim	A	14.9	30.8	25.5	37	1.5
		B	19.7	23.9*	6.0*	—	5.2
		C	20.6	31.8	26.6	32	5.2
	Spokes	A	16.2	30.9	21.6	22	3.1
		B	20.6	33.2	15.5	24	6.2
		C	20.6	31.0*	14.5*	28	4.2

A, unannealed; B, annealed and air-cooled; C, annealed and furnace-cooled.
* These test pieces showed defects.

tangentially and then from the spokes; in the case of the samples from the rim the unannealed samples (A) and those cooled in the furnace (C) were taken from the outer edges, and those cooled in the air (B) from the centre of the rim. All the tensile-test samples were 20 mm. in diameter and 100 mm. in length between pop marks. The notched-bar shock test pieces measured 10 × 10 × 60 mm. with a round notch. The annealing of the roughly sawn-out samples was done at a temperature of 1,000 deg. C for a quarter of an hour.

In the case of the high-silicon cast steel tested the elongation was about 30 per cent. higher than in ordinary cast steel. The elastic limit was considerably raised by the annealing. The increased tensile strength as a result of annealing depended on the carbon content. The elongation on the whole was not improved by annealing. The specific work in shock testing was very considerably increased almost throughout by annealing. The tests showed that the annealing temperature used (1,000 deg.) was correct. It must be much higher in the case of high-silicon than with ordinary cast steel. Steel with a high-silicon content, on the other hand, is less sensitive to excessive annealing than straight carbon steel.

The size of grain was throughout rather coarse, but diminished with increasing carbon content. Pearlite was only of occasional occurrence, forming the usual Widmannstätten figures. Samples which had been annealed at 1,000 deg., exhibited a fairly uniform fine-grained structure. The samples annealed at 1,100 deg., however, already showed signs of incipient deterioration.

As shown by the results of the tests, silicon steel appears most promising for steel castings, provided due attention is paid in its manufacture, and more particularly in the annealing, to the special characteristics of steel alloyed with silicon.

"Thorncliffe" Cast-Iron Houses.

On a recent visit to the Thorncliffe Ironworks our representative had an opportunity of inspecting the cast-iron houses already built and in process of erection by Newton, Chambers & Company, Limited, of the Thorncliffe Ironworks, Chapeltown, Sheffield. The building of cast-iron houses, one might almost say, is the natural evolution of a works where for upwards of 150 years the production of cast-iron plates for tank work has been an outstanding speciality. The plates for the houses are made 3 ft. square, with make-up plates 3 ft. by 18 in. On the outside of the plates are a series of dovetail keys, whilst the plates themselves are formed with a flange, much in the form of a flat lid. Before leaving the works the plates receive on the outside a coating of concrete ⅜ in. in thickness, which is applied by hand, stuccoed, and, of course, is held in position by the dovetail joints referred to. The concrete is chamfered off at the edges of the plates, so that when the plates are assembled in position the edges form a V-groove for the cement jointing. The corner members with square edges are cast in one piece. In erection wooden strips are placed between the recessed portions of the plates, thus forming a perfect joint, the outer joints being finished off in cement, so that the whole building, especially after a period of weathering, closely resembles stonework. The division walls and chimney breasts are built of 9-in. brickwork, bonded into the cast-iron shell.

The internal walls are formed of wood stoothing, properly bonded and strutted, and covered with heavy asbestos cement boards. The roof and porches are covered with red tiles. The windows are wood casements bolted into the cast-iron plates, with lights to open the full height of the window. The floors of the living rooms and bedrooms are of timber, and the floors of the scullery, larder, coal-place, and w.c. concrete.

The outstanding feature of this class of cast-iron building is that it is no more expensive than brick, over which it has the obvious advantages that it can be delivered from stock and erected on customers' foundations, by unskilled labour if needs be, in one week. Obviously, in view of the concrete coating, painting—an expensive incidental of the steel house—is wholly unnecessary. With regard to the useful life of such a structure, that has yet to be determined. Evidence of the weathering properties of cast iron may be seen at Thorncliffe Works, where a water tank constructed well over a century ago is still in active commission. Quite apart from the fact that the tank is constantly exposed to varying water levels, it is not even painted or otherwise protected on its outer sides, which are exposed to atmosphere.

"Thorncliffe" Cast-Iron Houses in Course of Erection.

The question naturally arises regarding the temperature of houses so constructed; in a word, the effect of the conductivity of the structure, as also the possible effect of expansion upon the concrete surface. With regard to the former, the concrete covering and the annular space in the wall forms a perfect non-conductor. With regard to the latter, it has been proved, with a cement-lined pipe, that the expansion between the iron and the concrete is the same, though it is interesting to note that of the houses erected very careful measurements were made daily during the summer to determine the amount of expansion, and this proved to be negligible. With the foregoing facts well established, it is obvious that native prejudice alone will prevent the more extensive use of cast iron as a building material, and it is well to think what effect a substantial increase in such erections might have upon our most depressed sections of industry—the iron and heavy foundry trades. If only fifty pairs of cast-iron houses were erected per week it would on one and other account find employment for some 250 men. It is interesting to know that the Minister of Health, having examined the houses, has given them his cordial approval, and has intimated that local authorities and private individuals will have no difficulty in obtaining his sanction for the necessary grants from the local authority.

Diagrams for Calculating Cupola Mixtures.

In "Die Giesserer," No 15, 1926 (April 10), Dr. H. Pflieger-Haertel describes a method of calculating cupola mixtures which is easier to handle than that of Zéla Szöke described in "The Iron Age," 116, No. 4, 1925, p. 205. In case only one component of the casting is to be determined, and two kinds of pig-iron are charged (according to the following table):—

Kind of Iron.	Si. per cent.	To carry to the Charge per cent.
Scrap	A	P
Pig Iron I.	a_1	x
Pig Iron II.	a_2	y

two linear equations must be solved:

$$a_1x + a_2y = A(100 - P) = A.Q \quad (1)$$
$$x + y = 100 - P = Q \quad (2)$$

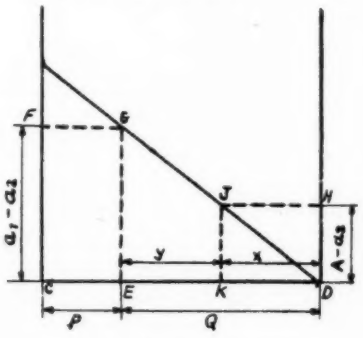

FIG. 1.

We eliminate y from equation (1) with the aid of equation (2), then

$$(a_1 - a_2).x = (A - a_2).Q \quad (3)$$

This equation is solved by the construction shown in Fig. 1:

CD = 100 per cent.,
CE = P,
ED = 100 − P = Q,
CF = EG = $a_1 - a_2$,
DH = JK = A − a_2.

From Fig. 1:

EG : ED = KJ : KD, that is
$(a_1 - a_2) : Q = (A - a_2) : KD$ and hence
$(a_1 - a_2) . KD = (A - a_2) . Q$.

Compared with equation (3) it follows:

KD = x and EK = y.

The total of these constructions for any value of a_1, a_2, P, Q, A can be arrived at in the following manner (Fig. 2):—On squared paper a horizontal line is drawn for P scaled to 100 from the left to the right. At the points 0 and 100 we

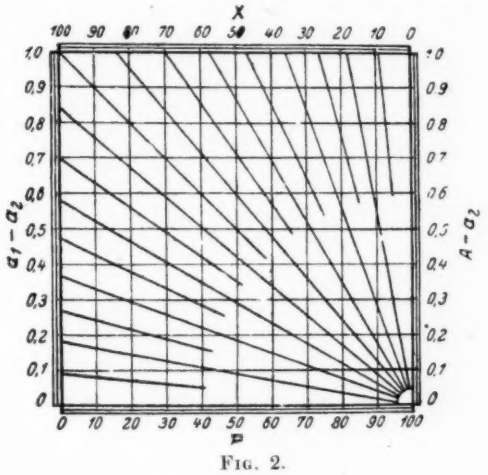

FIG. 2.

erect two perpendicular lines, the left one for the values of $(a_1 - a_2)$ and the right one for those of $(A - a_2)$; the two lines are on equal scales. Then we connect the extreme points of these lines by a line parallel to the base line and scale it to

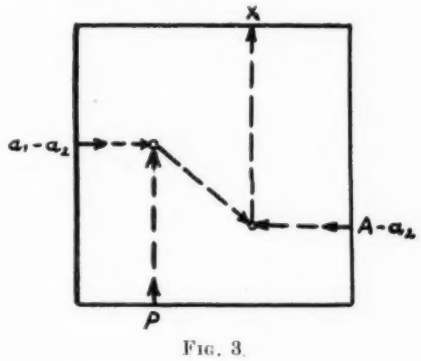

FIG. 3.

100 in the same scale as the base line, but in the contrary direction. Finally, a system of radiating lines is drawn through the point P = 100. The use of the table is thus: From the given value

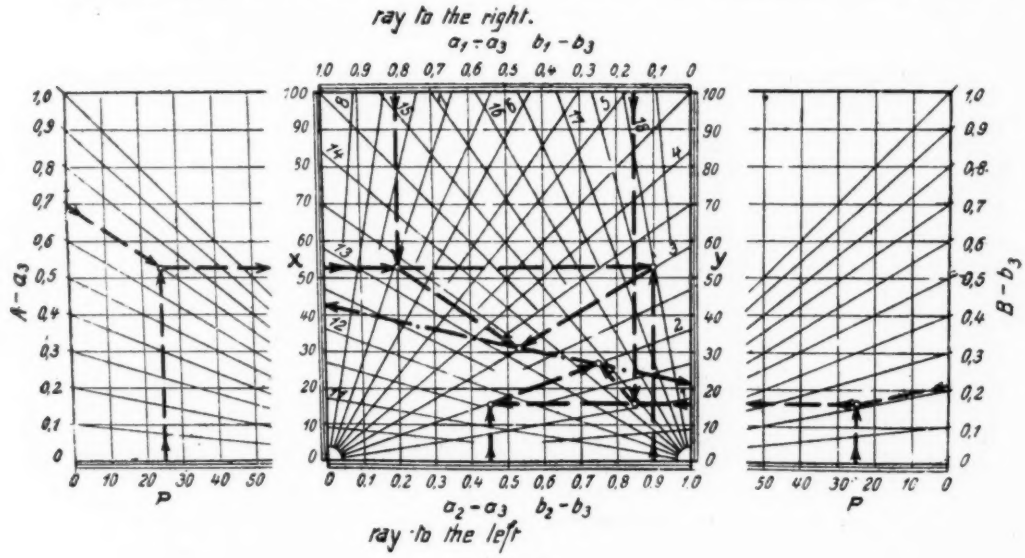

FIG. 4.

of $(a_1 - a_2)$ on the left vertical line we go horizontally to the right until we meet that line which is perpendicular to the base line at the given value of P. From the intersection of these lines

we advance along the corresponding ray until we meet the horizontal line which starts from the given value of $(A - a_3)$ on the right vertical line. From the intersection we go upward and find the value of x on the top line; then $y = 100 - P - x$. Fig. 3 is a scheme of the directions for use just described. It is profitable to draw such a scheme in one corner of the diagram in order to have the working of the method always in sight.

In the case of three kinds of pig-iron the percentages x, y, z of each kind of iron must be determined. Thus:—

Kind of Iron.	Si. per cent.	Mn. per cent.	To carry to the Charge, per cent.
Scrap	A	B	P
Pig Iron I.	a_1	b_1	x
Pig Iron II.	a_2	b_2	y
Pig Iron III.	a_3	b_3	z

Three linear equations must be solved:—

$$a_1x + a_2y + a_3z = A.Q \quad (4)$$
$$b_1x + b_2y + b_3z = B.Q \quad (5)$$
$$x + y + z = Q \quad (6)$$

From equation (6) it follows:—

$$z = Q - x - y.$$

This expression is inserted for z into the equations (4) and (5), and have equations with two unknowns:—

$$(a_1 - a_3) . x + (a_2 - a_3) . y = (A - a_3) . Q \quad (7)$$
$$(b_1 - b_3) . x + (b_2 - b_3) . y = (B - b_3) . Q \quad (8)$$

These equations are solved with the aid of parallel co-ordinates, as was clearly described in the article of Szöke mentioned above. In order to assemble the total of these constructions in one monogram, it is necessary to start off with the supposition: P = 0 and Q = 100. In this case we get values for x and y which are enlarged in proportion to 100:Q, and must be diminished in the reverse ratio. Instead of doing so we can use the values of $(A - a_3)$ and $(B - b_3)$ diminished in proportion to Q:100 at the outset. This is done in the monogram according to Fig. 4. The two auxiliary diagrams serve for reducing the given values of $(A - a_3)$ and $(B - b_3)$. From the vertical line for $(A - a_3)$ in the left auxiliary graph we advance along the corresponding ray to the right until we meet the line which is perpendicular to the base line at the given value of P. From the intersection of these two lines we go horizontally to the right into the main table. The rays of the auxiliary graph go through the point P = 100. In the same manner we reduce the given value of $(B - b_3)$ with the aid of the right-hand graph, and transfer the reduced value into the main graph by a horizontal line. The top line of the main graph is scaled for the values of $(a_1 - a_3)$ and $(b_1 - b_3)$ from the right to the left, the bottom line for the values of $(a_2 - a_3)$ and $(b_2 - b_3)$ in the contrary direction. We start from the given value of $(a_1 - a_3)$ on the top line and go downward until we meet the horizontal line coming from the left-hand graph. The intersection of these two lines determines the ray going to the right bottom corner. We find the corresponding ray to the left corner as the intersection of the line which is perpendicular to the bottom line at the given value of $(a_2 - a_3)$, and the horizontal line coming from the left-hand graph. The intersection of the two rays forms one point of that line which cuts the vertical lines of the main table at the sought values of x and y (the dot and dash line of Fig. 4). In the same manner we find a second point of this line with the aid of the values of $(B - b_3)$, $(b_1 - b_3)$, $(b_2 - b_3)$. It is to be noted that the rays going to the right corner are determined by the vertical lines coming from the top of the graph, and the rays going to the left corner by the vertical lines erected on the bottom line of the graph; hence the two notes in Fig. 4: "ray to the right," respectively, "ray to the left." In order to facilitate the handling of the rays it is profitable to furnish them with serial numbers.

An Easy Method of Distinguishing Iron from Steel.—It is at times difficult to distinguish iron from steel. An easy and reliable test is to pour some concentrated nitric acid on each. The iron will remain unaffected, but a black spot will be produced on the steel. Hard steel shows a very dark spot.

A Further Staveley Appointment.

Mr. H. H. Berresford, who has just been appointed to the position of commercial manager of the Staveley Coal & Iron Company, Limited, was educated at Chesterfield Grammar School, Nottingham High School, Nottingham University College, and London University. He entered the Staveley Company's accountants' department in 1898, and qualified by examination for the Chartered Institute of Secretaries, being placed in order of merit for his year. Later he was appointed Public Auditor under the Friendly Societies Act, during which time he acted

Mr. H. H. Berresford.
(Commercial Manager of the Staveley Coal & Iron Company, Limited.)

amongst other things as auditor for the Derbyshire Miners' Association. Mr. Berresford is a director of the Yorkshire Main Colliery Company, Limited, Markham & Company, Limited, Chesterfield Brick Company, Limited, the Staveley, Eckington, Clowne, Shirebrook, and Brimington electric supply companies.

French Founders and Currency Instability.

Troubles due to the instability of the franc exchange were discussed at some length at the August meeting of the Syndicat General des Fondeurs de France. Some members were even asking for the prohibition of the export of pig-iron, in order to bring the price within the purchasing power of the domestic user.

Payment for iron was also discussed, the new conditions imposed by the furnace owners being objected to on the grounds that the whole of the raw materials used in blast furnaces were of local origin. It was decided to adopt the system of net cash 30 days. It was announced by M. Dufour, the President, that the General Manager of the Eastern Railway Company had given instructions for closed trucks to be supplied for all castings necessitating such trucks.

Later the same day the brassfounders met under the chairmanship of M. Devaux. They, too, went into the question of paying for raw materials, and it was decided to adopt the following system: one-third as cash with order, one-third as a 60-days' accepted banker's draft at the end of that month, and one-third net cash at end of the month in which deliveries are effected.

It was the unanimous wish of those present that a co-operative buying organisation should be created in order to assure the stocking of the works with imported metallic raw materials under the most favourable conditions.

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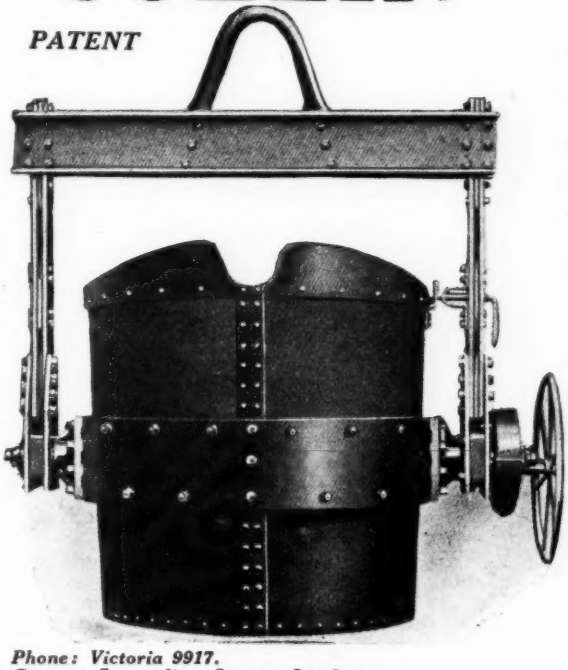

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Choosing and Training Foremen.

By Voyageur.

It is useless to search for the ideal foreman. The ideal foreman would possess specialised technical knowledge and experience, allowing him to supervise the work of the men under him, and moral qualities enabling him to inspire them to do their best. The two things are rarely found united in the same person. Therefore the employer must dismiss as impracticable any discovery of a man or men so gifted, and, having decided what qualities he wants, choose men who most nearly approach the ideal.

In order of importance these are the things the foreman should have: Intelligence; experience or technical knowledge; practical skill or bodily strength; diplomacy; ability to stick at a difficult task; vigour; loyalty; sound constitution; balance; some education; adaptability. In many works, even to-day, foremen are chosen from among men who have shown themselves expert in the performance of one particular operation; who have been prompt and punctual in their attendance at work; who have been in the service of the firm for a long time; or whose diligence has impressed the management. But the principles on which choice of this kind is made are unsound, and must be condemned. The mere exhibition of individual skill is no guarantee of success in leadership. Dexterity at a particular job is often acquired at the expense of adaptability and understanding of other kinds of work. Again, scientific study of motions has shown that the quickest worker at a particular operation does not always employ the most generally efficient methods, which unfits him as an instructor for others less gifted than himself. Similarly, none of the other marks of good conduct is *in itself* sufficient proof of ability to control labour.

Scientific Training Necessary.

There is only one sound way of maintaining an adequate supply of capable foremen, and that is to pick them out at an early stage in their careers and train them scientifically for their future duties. But before this training is described it will be as well to dispose of two wrong ideas very prevalent in English machine-shops and elsewhere. One is that a foreman should be tried out for a month or so before being definitely entrusted with the work. The other is that the workers themselves will choose a good leader from among their own number, and work better under him than under one imposed upon them by the management. Both theories are seductive but false, because they do not work well in practice. In the first case, the knowledge that the management's eyes are on him often makes a man nervous, less ready to take responsibility, than he would be if given the job and told to do his best. The men know that his authority is only temporary, and that he may return to equality with them at the end of a few weeks. This renders them less ready to obey his instructions, or to prove tractable. The foreman on trial dares not reprimand them too sharply, knowing that he also may before long be one of them again. He is afraid, too, of the humiliation involved in having an order countermanded by the works or shop manager. And in one shop known to the writer this sense of the difficulties of the "on trial" position was so strong that not a man in the place would take the foreman's job on those terms.

In the second case, while the idea of the men choosing their own leader sounds democratic, it is not so in its results. Personal jealousies or favouritisms lead to men being chosen who are certainly not the best for the job. The best men often hesitate to push their claims among their mates, or are too modest to do so, and the position is often given to the least scrupulous or longest-tongued. Having chosen a foreman by vote, the men are apt afterwards to resent any assumption on his part of superiority when he has taken charge, and often prove insubordinate. He, in turn, often feels himself under an obligation to them for having gained him promotion, and dislikes to adopt stringent measures, even when these are necessary.

The best method is to pick out by observation a number of likely men as eventual candidates for foremen's positions. Then, long before any such position becomes vacant, the management should begin a course of instruction for them. They should be taught the duties of a foreman, what he ought to know, and how to deal with men in the mass and individually. A course of this kind, with its opportunity of learning the responsibilities of promotion, will frighten off the weaker-minded, men who feel insufficiently self-confident to take up the work. The others will understand their duties better when the time comes to assume them.

Difficulties Involved.

Two possible dangers to the scheme must be avoided. The foremen in the workshops where these chosen candidates are employed must not be allowed to imagine their own security threatened. The object of the scheme must be explained to them, and they should have some material guarantee that they will not suffer by helping it on. Otherwise, they will prove active opponents. Fairness at present foremen is essential to the success of the plan.

The second danger is imperfect instruction. This work must not be left to the foreman alone. The shop-manager or superintendent must do some of it. He knows what sort of foremen he wants under him; knows the relation his shop bears to the works as a whole, and to the other shops in detail; he can supplement the foreman's practical instruction with his own wider knowledge and education.

Instruction of these young candidates does not need a class-room or tables. It can be given in the ordinary course as circumstances permit, but a day should not go by without something being imparted, so that by degrees each of the chosen men is brought up to an appreciation of the higher standard required of him. The response to this tuition will prove another means of gauging a man's abilities.

But even when a candidate has attained his goal and become a foreman, his instruction must not come to an end. In one large works everything is done to maintain the foremen on the highest level of efficiency. They are taught—and in this respect a great deal is due to the unselfish work of the technical managers and staff—the problems of the industry as a whole, so that prejudice and misunderstanding of big industrial and economic issues are eliminated as far as possible. This firm sends two or three of its foremen in turn to the industrial conferences held in Oxford and elsewhere. Here they listen to famous lecturers and authorities on labour and industrial problems and gain some idea of the intricacy of social adjustments. They discover, often for the first time, that intelligent people are thinking out these important matters. One foreman confessed that attending a conference of this sort had made him think himself, and, as a result, he had entirely altered his way of dealing with the men under him—a much bigger output being the immediate practical result.

The same firm publishes for the benefit of its customers a little technical magazine dealing with its own products. A copy of this journal (published monthly) is sent to every foreman in the works. The object of this is to indicate the eventual destination of the goods produced; to make them understand the problems of the consumer; to make them perceive the importance of good workmanship in maintaining the firm's high place in its own particular sphere; and insensibly to lead them to acquire something of the team-spirit.

Every now and then members of the technical staff give lectures to the foremen on practical aspects of their work. There is no compulsion about attendance. The subjects are, however, well chosen, the papers not too long and not too theoretical, and the attendance is in consequence usually large. Time is given for questions and discussion. The foremen are urged to give lectures or papers themselves, either to their men, to their own body, or to apprentices. Again, compulsion is not attempted, and if a suggestion is not taken up the matter is dropped. There is no question of victimisation for failure to respond.

The total result of all this training is to give the foremen a greater interest in their duties; to make them better, broader, and more intelligent workers; and, in consequence, to improve the production-activities as a whole.

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GENERAL REFRACTORIES
Co. Ld. SHEFFIELD.

BCM/OK9
LONDON.

No need to try and remember our name in case it is unfamiliar to you. This is our British Monomark. Envelopes addressed simply thus will be delivered to us by arrangement with the G.P.O.

Trade Talk.

A FIRE OCCURRED on August 13 at the Regica Iron Foundry, Church Lane, West Bromwich. The outbreak was, however, extinguished before much damage was done.

THE STAVELEY COAL & IRON COMPANY, LIMITED, have secured from the Chesterfield Rural District Council, in connection with a big sewerage scheme, a contract for cast-iron pipes amounting to £12,783.

THE LONDON, MIDLAND & SCOTTISH RAILWAY COMPANY are building at their Norwich and Crewe works 100 new 2-6-0 superheater locomotives, which have been designed to handle fast goods traffic and heavy excursion trains.

A SUPPLEMENTAL TRUST DEED, dated July 29, 1926, has been registered in connection with Barrow Haematite Steel Company, Limited, securing a further £219,607 5 per cent. (income-tax free) first debenture stock, redeemable at 2½ per cent. premium, and ranking *pari passu* with the £1,000,000 like debenture stock (of which £780,393 was outstanding on July 1, 1926), secured by a trust deed of June 10, 1919, and supplemental deed of November 8, 1919. The property charged is that comprised in the original trust deed.

THE REPORT of the joint inquiry by the Shipbuilding Employers' Federation and the shipyard trade unions into foreign competition and conditions in the shipbuilding industry was considered at York last week by a fully representative meeting of the Shipbuilding Trades' Federation. The meeting eventually adjourned to a date in September without any decisions being made as to the application of the recommendations in the report, so that the results which were hoped for from an adoption of the findings will be delayed.

IT IS UNDERSTOOD that Mr. Daniel Radcliffe, of South Wales, has purchased, with a view to reopening when conditions improve, the engineering works of Messrs. Blair & Company, Limited, at Stockton-on-Tees, which it was feared had been permanently closed. Mr. Radcliffe has large interests in shipping concerns, being vice-chairman of the Bute Shipbuilding, Engineering & Dry Dock Company, Limited, Tredegar Dry Dock & Wharf Company, Limited, and Cardiff Channel Dry Docks & Pontoon Company.

AT THE LAUNCH of the new steamer "Sheringham," for the Harwich-Rotterdam service, at Earle's shipyard, Hull, last Saturday, Mr. W. S Hide, chairman of Earle's, said it had become a precarious adventure to take an order for a new ship in this country. Most shipbuilding firms were satisfied if they could build a ship without making a loss, because they were anxious to keep their staffs employed. The launch of the "Sheringham" was delayed one month owing to the coal stoppage. It was originally intended that the vessel should be all-British, but steel plates had to be obtained from abroad.

A NUMBER OF important contracts for locomotive and rolling stock equipment for Indian and other overseas railways have recently been placed with British and Continental builders. Included among these are orders placed with the Leeds Forge Company, Limited, for 68 bogie rail and timber trucks, North-Western Railway; 112 bogie low-sided and 30 bogie high-sided wagons, Indian State Railways; 60 covered goods wagons, and ten timber trucks, South Indian Railway; 20 covered and 20 high-sided goods wagons for the narrow-gauge lines of the Bengal-Nagpur Railway; and 60 low-sided wagons for the Jodhpur-Bikanir Railway; all to be fitted with Sheffield-Twinberrow bogies. Sixteen 4-6-0 standard type superheated mixed-traffic (class B) locomotives and tenders for metre-gauge lines of the South Indian Railway have been ordered from Robert Stephenson & Company, Limited, Darlington, and eight 0-6-0 (class K) goods locomotives and tenders for the broad-gauge section of the same railway have been requisitioned from Nasmyth, Wilson & Company, Limited, of the Patricroft Foundry, Manchester. The English Electric Company, Limited (of Preston, Lancs.), have received the contract from the High Commissioner for the Government of India for 15 motor-coach and 42 trailer-coach equipments for the Kalyan extension of the Great Indian Peninsula Railway electrification, which is a repeat of the first order for the electrical equipment for 38 motor-coaches and trailer equipment for 111 trailer coaches. The High Commissioner for the Government of India has also awarded a contract for twelve 750-volt rotary converters to be coupled in series for 1,500-volts to the English Electric Company, who are, in addition, supplying 22-000-volt transformers and automatic direct-current switchgear for three complete units. Messrs. Beyer, Peacock & Company, Limited, of Gorton Foundry, Manchester, have received from the Entre Rios Railway Company a contract for five Garratt patent articulated 2-6-0—0-6-2 locomotives of a type generally similar to three locomotives of this special design already in service on the Argentine North-Eastern Railway. The Vulcan Foundry, Limited, of Newton-le-Willows, Lancs., have been instructed by the Crown Agents for the Colonies to build two 2-6-2 tank superheated engines for the Tanganyika Railways. Metropolitan Vickers Electrical Company, Limited, Trafford Park, Manchester, have received from the Great Indian Peninsula Railway an order for an electric passenger locomotive of 2,260 h.p., capable of attaining a safe travelling speed of 85 miles per hour.

Obituary.

THE DEATH took place on Tuesday last week of Sir Arthur Pendarves Vivian, of Bosahan, St. Martin, Cornwall. He had copper and coal interests in Glamorgan and Cornwall.

MR. ALFRED ERNEST TERRY, St. Leonard's Grange, Beoley, a director and a partner of the firm of Messrs. Herbert Terry & Sons, Limited, spring manufacturers, Redditch and Alcester, died on Monday last week.

MR. B. GRANGER HARRISON, managing director of Granger Harrison & Company, Limited, iron-ore merchants, of 85, Gracechurch Street, London, E.C., died on August 12, aged 46, after a long illness.

THE DEATH took place at Workington recently of Mr. Roland J. J. Hill, at the age of 73 years. Until a few years ago, when he retired, deceased was a rail inspector for the United Steel Companies, in which capacity he had travelled extensively.

THE DEATH IS ANNOUNCED of Mr. Christopher James, who was chairman of Messrs. Joshua Buckton & Company, Limited, machine tool makers, Leeds. He was for some years a member of the Council of the Institution of Mechanical Engineers, and for some six months, in the year 1917, he was Director of Ammunition Production at the Admiralty.

New Companies.

Sir Robert McAlpine & Sons, Limited (London).—Capital £250,000 in £1 shares. Civil and general engineering contractors. Power is also taken to own and operate mines and quarries. Directors: Sir Robert McAlpine, Robert McAlpine, Wm. H. McAlpine, Sir Malcolm McAlpine, Alfred D. McAlpine, and Granville R. McAlpine. Solicitors: John Hands & Son, 97, Gresham Street, E.C.2.

The Midland Electric Manufacturing Company, Limited.—Capital £150,000 in £1 shares (75,000 7½ per cent. preference and 75,000 ordinary). To acquire the business of the Midland Electric Manufacturing Company, Limited, and the shares in the Birmingham Foundries, Limited. Directors: W. L. Barber, Birmingham, manufacturer; B. D. F. Docker, J. P., and C. H. Smith, Birmingham.

Iron and Steel Output in July.

The National Federation of Iron and Steel Manufacturers report that a natural consequence of the coal stoppage has been the almost complete cessation of production of pig-iron and steel. Of the 147 furnaces in blast on the eve of the stoppage only 8 were in operation at the end of July. Production of pig-iron has therefore fallen from 539,100 tons in April to 17,900 in July, and compares with 492,700 tons in July, 1925.

The production of steel ingots and castings in July amounted to 32,100 tons compared with 34,500 tons in June and 590,400 tons in July, 1925.

Personal.

IN OUR LAST ISSUE we incorrectly stated Mr. West, who recently underwent a surgical operation, was Metallurgist to Leyland Motors, Limited. Actually, Mr. West is Assistant Works Manager to the Farington Steel Foundry of Leyland Motors, the Metallurgist for Leyland Motors, Limited, and this foundry being Mr. C. C. Hodgson.

Wills.

BROWN, ADAM GILLISON, of Kelvinside, Glasgow, iron and steel merchant, ... £45,594

CRAWFORD, FREDERICK SEPTIMUS (92), of Eslington Terrace, Newcastle-on-Tyne, founder of Crawford Bros., steel merchants, Quayside, Newcastle (net personalty £15,444) £23,492

FOR

QUANTITY PRODUCTION.

For the production of castings in large quantities STERLING MOULDING BOXES are ideal. They possess all the vital qualities necessary for rapid handling—Lightness, rigidity, durability, permanent accuracy, freedom from distortion and freedom from breakage.

ALL STERLING BOXES are made to specification and to suit the individual needs of each foundry. They are designed for use with either fixed or loose pins, and we will drill them to suit your existing pattern plates or oddsides.

Let us go over your present box equipment and show you where STERLING BOXES will benefit you.

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London Office: 13, VICTORIA STREET, S.W.1.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—As reported previously, the position in the Cleveland iron trade has undergone little change for the better, and notwithstanding a more hopeful outlook with regard to future fuel supplies, conditions remain extremely unsatisfactory from producer's and consumer's point of view. There are now only very limited supplies of pig available for market purposes, though doubtless a big unsatisfied demand is banking up, and this will mean busy times for the industry when production is again possible on a commercial scale. But it is well to remember that, when that time comes, present prices must fall considerably and, as usual, the process of deflation may mean anxious periods for the manufacturer. However, there seems no reason to anticipate any further rise in Cleveland prices, which are steady and unchanged. No. 1 foundry iron is 92s. 6d., No. 4 foundry 89s., and No. 4 forge 88s. 6d. per ton.

In view of the scarcity of the usual qualities of foundry pig there is a fairly steady demand for hematite, and as stocks have now been reduced to a substantial extent prices have firmed up. East Coast makers now quoting up to 82s. 6d. per ton for mixed numbers, with the usual extra for No. 1 quality at 83s. On the North-West Coast also prices continue on the up-grade, Bessemer mixed numbers now being quoted at £4 10s. per ton delivered at Glasgow, £4 12s. 6d. per ton delivered at Sheffield, £4 17s. 6d. to £5 per ton delivered at Birmingham, and £4 4s. per ton c.i.f. Welsh ports.

Metals.

Copper.—Conditions in the standard copper market maintain satisfactory steadiness, fluctuations tending mostly in an upward direction, with values at slightly higher levels. Consumptive demand continues on a somewhat expanding scale, and there is every sign of increased values being reached and fully held in the near future. The increased consumption in the United States has so far not been reflected in the European markets, the demand on the Continent not having advanced to a similar degree, this no doubt being largely due to the erratic action of the French and Belgian franc; Germany, however, is reported to have been in the market recently for supplies for the brass-making industry.

Official closing prices of standard copper have been as follow :—

Cash : Thursday, £59 to £59 2s. 6d.; Friday, £59 to £59 2s. 6d.; Monday, £58 17s. 6d. to £59; Tuesday, £58 15s. to £58 17s. 6d.; Wednesday, £58 12s. 6d. to £58 15s.

Three Months : Thursday, £59 15s. to £59 17s. 6d.; Friday, £59 15s. to £59 17s. 6d.; Monday, £59 12s. 6d. to £59 15s.; Tuesday, £59 10s. to £59 12s. 6d.; Wednesday, £59 7s. 6d. to £59 10s.

Tin.—Following a temporary set-back in the previous week, the position of this metal has further improved, and at one stage again approached the £300 level, with a good demand for both cash and forward. The set-back recently is said to be due to speculative movements in Wall Street, and when this is generally realised, and a more settled position is gained, further improvement may be looked for.

Official closing prices of standard tin have been as under :—

Cash : Thursday, £295 to £295 10s.; Friday, £294 to £294 5s.; Monday, £294 to £294 5s.; Tuesday, £291 12s. 6d. to £291 15s.; Wednesday, £293 to £293 5s.

Three Months : Thursday, £289 to £289 5s.; Friday, £288 5s. to £288 10s.; Monday, £288 5s. to £288 10s.; Tuesday, £286 10s. to £286 12s. 6d.; Wednesday, £288 10s. to £288 15s.

Spelter.—Demand for this metal continues steady, alike in the home and Continental markets. Consumption in the United States continues on an expanding scale, and should this movement be maintained, a shortage would appear inevitable unless production is materially increased.

The following are the week's prices :—

Ordinary : Thursday, £34 7s. 6d.; Friday, £34 7s. 6d.; Monday, £34 5s.; Tuesday, £34 3s. 9d.; Wednesday, £33 18s. 9d.

Lead.—The market for soft foreign pig has been subject of late to slight fluctuations of values, but maintains a steady tendency on the whole. There now seems to be an impression that a steadier level will be attained in the near future, when the belief that the market is being worked by owners of hidden supplies has worked off.

The week's prices are appended :—

Soft foreign (prompt) : Thursday, £32 18s. 9d.; Friday, £32 18s. 9d.; Monday, £32 17s. 6d.; Tuesday, £32 11s. 3d.; Wednesday, £32 5s.

Telegrams : WILLIAM OLSEN, HULL.
Nat. Tel. : 1184. *Established* 1890.

NO FANCY NAMES
NO FANCY PRICES

"PEERLESS" is not a fancy name, but denotes QUALITY

OUR
"Peerless" Core Sand Binder
"Peerless" Core Oil Paste
"Peerless" Parting Powders
"Peerless" Metallic Cement
are the best obtainable and our Prices moderate.

ALWAYS IN STOCK. CARR. PAID TERMS.

All who have not hitherto bought these articles from us are invited to try them.

— *SATISFACTION ASSURED* —

WILLIAM OLSEN, Ltd.
HULL.

Penman & Co., Ltd.
Caledonian Ironworks,
GLASGOW, S.E.

Type F. 5-ton Foundry Ladle.

LADLES for HARD SERVICE
from 28lb. to 28 tons.

Catalogues and Quotations on Application

With all-steel enclosed gears.
Perfectly balanced for easy tilting.

THE TEST

of ganister to the user is not the cost per ton nor the life per ton, but the life per £ of the cost. If you purchase from us a truck of the

GENUINE
SHEFFIELD GANISTER

and apply this test you will find a decided reduction in your working costs.

Made from the best raw materials, manufactured in scientific and up-to-date plant and sold at a keen price our ganister is something you cannot afford to miss.

Let us Reduce your Costs.

WEBSTER & CO. (SHEFFIELD), LTD.

18, Foster's Buildings, High Street, SHEFFIELD.

'Phone: Central 576. **'Grams: "Webco," Sheffield.**

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	58	12	6
Three months	59	7	6
Electrolytic	66	10	0
Tough	65	0	0
Best selected	65	10	0
Sheets	90	0	0
India	73	0	0
Wire bars	67	5	0
Do. Sept.	66	15	0
Do. October	66	15	0
Ingot bars	66	15	0
H.C. wire rods	71	0	0
Off. av. cash, July 57	18	6	5/11
Do., 3 mths. July 58	13	11	8/11
Do.,Sttlmnt, July 57	17	11	5/11
Do., Electro, July 65	17	0	5/11
Do., B.S., July	64	0	10
Aver. spot price copper, July	57	17	11½
Do.,wire bars, July	66	1	7
Solid drawn tubes			13d.
Brazed tubes			13d.
Wire			9¾d.

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10⅝d.
Wire	10½d.
Rolled metal	9⅞d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	293	0	0
Three months	288	10	0
English	291	0	0
Bars	292	10	0
Straits	299	0	0
Australian	—		
Eastern	294	10	0
Banca	—		
Off.avr. cash, July282	3	11	1/32
Do.,3 mths., July280	5	9	5/11
Do., Sttlmt. July282	2	11	5/11
Aver. spot., July 282	3	11	

SPELTER.

	£	s.	d.
Ordinary	33	18	0
Remelted	33	15	0
Hard	29	0	0
Electro 99.9	37	10	0
English	34	17	6
India	31	10	0
Zinc dust	43	0	0
Zinc ashes	16	0	0
Off. aver., July	34	3	1 21/64
Aver., spot, July	33	0	11

LEAD.

	£	s.	d.
Soft foreign ppt.	32	5	0
English	33	15	0
Off. average, July 31	12	7	7/16
Average spot, July 31	14	3	3½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	42	15	0
Do. V.M. ex whf.	40	0	0
Rods	45	0	0
Boiler plates	39	0	0
Battery plates	38	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	74	10	0
Chinese	65	0	0
Crude	40	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	15	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

	£	s.	d.
Ferro-silicon 25%	9	3	0
45/50%	10	5	0
75%	17	4	0
Ferro-vanadium— 35/40%	15/- lb. va.		
Ferro-molybdenum— 70/75% c. free	5/6 lb.		
Ferro titanium— 23/25 carbonless	11d½.		
Ferro-phosphorus, 20/25%,	£17	0	0
Ferro-tungsten— 80/85%,c.fr.	1/4½ lb.		
Tungsten metal powder— 98/99%	1/10½ lb.		
Ferro-chrome— 2/4% car.	£33	0	0
4/6% car.	£22	0	0
6/8% car.	£21	10	0
8/10% car.	£20	15	0
Ferro-chrome— Max. 2% car.	£37	0	0
Max. 1% car.	£43	10	0
Max.0.70%car.	£54	10	0
70%,carbonless	1/5½ lb.		
Nickel—99%, cubes or pellets	£170		
Cobalt metal—98/99%	10/- lb.		
Aluminium 98/99%	£118		
Metallic Chromium— 96/98%	3/3 lb.		
Ferro-manganese (net)— 76/80%, loose	£14	0	0
76/80%, packed	£15	0	0
76/80%, export	£14	0	0
Metallic manganese— 94/96%, carbonless	2/- lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—
Rounds and squares 3 in. and over 4d.lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Do. under ¼in. to 1/8 in. 1/- lb.
Flats, ½in. × ¼in. to under 1 in. × ⅛ in. 3d. lb.
Do. under ½in. × ¼in. 1/- lb
Bevels of approved sizes and sections 6d. lb.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Hvy. steel	2	10	0	to 2	15	0
Bundled steel & shrngs.	2	0	0	to 2	5	0
Mixed iron & steel	2	0	0	to 2	5	0
Heavy cast iron	3	0	0			
Good machinery for foundries	3	5	0			
Cleveland—						
Heavy steel	3	1	0			
Steel turnings	2	6	0			
Cast iron borings	2	5	0			
Heavy forge	4	2	6			
Bushelled scrap	3	10	0			
Cast-iron scrap	3	8	6	to 3	10	0
Lancashire—						
Cast-iron scrap	3	2	6	to 3	10	0
Hvy. wrought	3	2	6			
Steel turnings	2	2	0			

London — Merchants' buying prices delivered yard.

	£	s.	d.
Copper (clean)	49	0	0
Brass (clean)	39	0	0
Lead (less usual draft)	28	10	0
Tea lead	24	10	0
Zinc	23	0	0
New aluminium cuttings	80	0	0
Braziery copper	45	0	0
Gunmetal	46	0	0
Hollow pewter	190	0	0
Shaped black pewter	138	0	0

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—
Foundry No. 1 92/6
Foundry No. 3 90/-
Foundry No. 4 89/-
Forge No. 4 88/6
Hematite No. 1 83/-
Hematite M/Nos. 82/6

N.W. Coast—
Hem. M/Nos. d/d Glas. 88/-
„ d/d Birm. 100/-

Midlands—
Staffs common* —
„ No. 4 forge —
„ No. 3 foundry —
Shrops. basic —
„ Cold blast, ord.* —
„ „ roll iron* —
* d/d Birmingham.

Northants forge —
„ fdry No. 3 —

Derbyshire forge —
„ fdry. No. 3 —
„ basic —

Scotland—
Foundry No. 1 —
„ No. 3 87/6
Hem. M/Nos. 80/-

Sheffield (d/d district)—
Derby forge —
„ fdry. No. 3 —
Lincs. forge —
„ fdry. No. 3 —
E.C. hematite 94/6
W.C. hematite 92/-

Lincs. (at furnaces)—
Forge No. 4 —
Foundry No. 3 —
Basic —

Lancashire (d/d eq. Man.)—
Derby forge —
„ fdry. No. 2 —
Northants foundry No. 3 —

Dalzell, No. 3 110/-
Summerlee, No. 3 107/6
Glengarnock, No. 3 107/6
Gartsherrie, No. 3 107/6
Monkland No 3 107/6
Coltness, No. 3 107/6
Shotts, No. 3 107/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.) nom.	11	10	0	to 13	0	0
Angles				12	0	0
Tees to 3 united ins.				12	10	0
Nut and bolt				—		
Hoops				14	10	0
Marked bars (Staffs.) f.o.t.				14	0	0
Gas strip				12	10	0
Bolts and nuts ⅜ in. × 4 in.				15	5	0
Steel—						
Ship plates				8	2	6
Boiler plts.				11	5	0
Chequer plts.				9	10	0
Angles	7	7	6	to 7	10	0
Tees	8	7	6	to 8	10	0
Joists	7	7	6	to 7	10	0
Rounds and Squares 3 in. to 5½ ins.				9	0	0
Rounds under 3 in. to ⅜ in.				8	15	0
Flats, over 5 in. wide and up				9	10	0
Flats, 5in. to 1½in.				8	10	0
Rails, heavy				8	10	0
Fishplates				12	10	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				17	0	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft				—		
Billets, hard				8	2	6
Sheet bars				—		
Tin bars d/d				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3¾
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free
10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

Per lb.
Ingots for raising 9d. to 1/3
Rolled—
To 9 in. wide 1/3 to 1/9
To 12 in. wide 1/3½ to 1/9½
To 15 in. wide 1/3½ to 1/9½
To 18 in. wide 1/4 to 1/10
To 21 in. wide 1/4½ to 1/10½
To 25 in. wide 1/5 to 1/11
Ingots for spoons and forks 9d. to 1/5½
Ingots rolled to spoon size 1/- to 1/8½
Wire round—
3/0 to 10 G. 1/6½ to 2/1½
with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	21 76
No. 2 foundry, Valley	19.26
No. 2 foundry, Birm.	21.00
Basic	19.26
Bessemer	19.76
Malleable	19.26
Grey forge	18.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.10
Sheets, galv., No. 28	4.20
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
„ furnace	—
Durham & North. foundry	—
„ furnace	48/6
Other Districts, foundry	—
„ „ furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes, 20×14, box		24/-
„	28×20, „	49/-
„	20×10, „	—
„	18⅞×14, „	—
C.W.	20×14, „	21/6
„	28×20, „	—
„	20×10, „	—
„	18⅞×14, „	—

Terneplates 28×20, — per box basis f.o.b.

SWEDISH IRON.

Bars,hammered £18/10 to £19/0
Rolled Ord. £15/10/0 to £16
Nail rods £16 5 0 to £16 15 0
Keg. steel nom. £33 to £35
Faggot steel nom. £22 to £25
Blooms, according to quality £9 to £12
Pig-iron £6 0 0 to £6 10 0 all f.o.b. Gothenburg.

TUBES AND FITTINGS.
Up to and incl. 6 in.

	Tubes	*Fittings*
Gas	60%	50%
Water	55%	45%
Steam	50%	40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Aug. 19	59	0	0	No change
,, 20	59	0	0	,, ,,
,, 23	58	17	6	dec. 2/6
,, 24	58	15	0	,, 2/6
,, 25	58	12	6	,, 2/6

Electrolytic Copper.

	£	s.	d.	
Aug. 19	67	0	0	No change
,, 20	67	0	0	,, ,,
,, 23	66	15	0	dec. 5/-
,, 24	66	15	0	No change
,, 25	66	10	0	dec. 5/-

Standard Tin (Cash).

	£	s.	d.	
Aug. 19	295	0	0	inc. 60/-
,, 20	294	0	0	dec. 20/-
,, 23	294	0	0	No change
,, 24	291	12	6	dec. 47/6
,, 25	293	0	0	inc. 27/6

Tin (English ingots).

	£	s.	d.	
Aug. 19	294	0	0	inc. 40/-
,, 20	293	0	0	dec. 20/-
,, 23	293	0	0	No change
,, 24	290	10	0	dec. 50/-
,, 25	291	0	0	inc. 10/-

Zinc Sheets (English).

	£	s.	d.	
Aug. 19	42	15	0	No change
,, 20	42	15	0	,, ,,
,, 23	42	15	0	,, ,,
,, 24	42	15	0	,, ,,
,, 25	42	15	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Aug. 19	34	7	6	inc. 3/9
,, 20	34	7	6	No change
,, 23	34	5	0	dec. 2/6
,, 24	34	3	9	,, 1/3
,, 25	33	18	9	,, 5/-

Lead (English).

	£	s.	d.	
Aug. 19	34	0	0	No change
,, 20	34	5	0	inc. 5/-
,, 23	34	5	0	No change
,, 24	33	15	0	dec. 10/-
,, 25	33	15	0	No change

Exports of Iron Castings in July and the seven months 1926, compared with July and the seven months 1925.

	July, 1925	July, 1926	Seven months, 1925	Seven months, 1926	July, 1925	July, 1926	Seven months, 1925	Seven months, 1926
BUILDERS' CASTINGS—	Tons.	Tons.	Tons.	Tons.	£	£	£	£
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers—								
To Argentine Republic	107	122	877	783	5,727	7,155	32,635	33,097
,, British South Africa	358	135	2,235	2,496	12,341	5,930	79,203	85,112
,, ,, East Indies	110	164	1,007	1,048	4,179	7,125	47,248	46,349
,, Australia	27	91	411	557	1,520	4,110	22,597	30,851
,, New Zealand	222	171	1,600	1,359	9,898	8,823	74,670	65,598
,, Other countries	614	759	4,463	4,682	31,817	33,712	226,719	222,100
Total	1,438	1,442	10,593	10,925	65,482	66,855	483,072	483,107
PIPES AND FITTINGS—CAST—								
To Argentine Republic	1,120	513	6,996	5,156	13,492	6,095	89,294	64,243
,, British South Africa	369	1,319	4,523	5,057	5,751	14,214	62,925	67,064
,, ,, India	493	499	6,183	5,732	6,450	7,361	87,418	71,885
,, Straits Settlements & Malay States	832	934	3,981	10,796	10,483	9,874	47,123	91,851
,, Ceylon	63	165	852	1,399	752	1,690	10,539	15,331
,, Australia	140	387	2,136	2,935	3,209	6,355	33,614	38,307
,, Other countries	4,704	4,058	32,872	30,306	69,125	57,091	488,711	412,710
Total	7,721	7,875	57,543	61,381	109,262	102,680	819,624	761,391
HOLLOW-WARE—								
Cast, not Enamelled, and Cast, Tinned	530	634	4,828	4,080	22,170	25,089	162,001	142,343
,, Enamelled	108	74	613	541	10,576	9,707	61,369	57,533
CASTINGS, in the rough—								
Iron	118	143	872	977	4,065	3,554	32,565	27,014
Steel	156	86	434	486	5,461	2,736	17,328	14,005

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36" × 24" rumbling barrel, new - - -	£12
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